Astronautics

A PUBLICATION OF THE AMERICAN ROCKET SOCIETY

FEBRUARY 1961

10-PAGE ANNUAL MEETING REPORT

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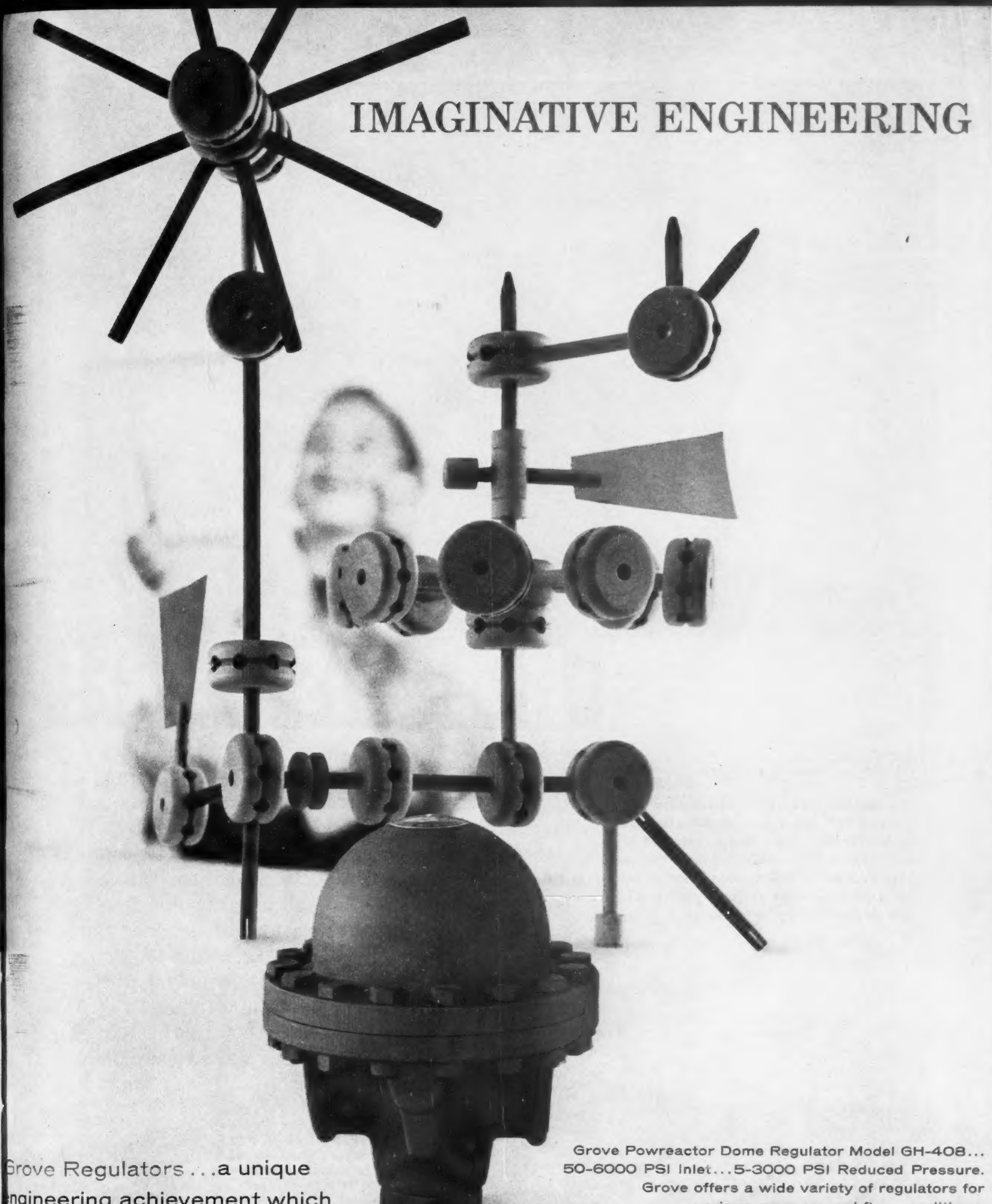
IMAGINATIVE ENGINEERING

COVER: Venus is the subject of this impressionistic treatment by Marshall Simpson and Roslynn Middleman, who did the painting as one of their well-known series on the planets. (ASTRO cover plaques, 11 by 12 in., are available from ARS Headquarters at $2.00 each.)

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Astro notes

SPACE SYSTEMS

• Atlas-Able 5B lifted perfectly off its launching pad and climbed into the dark sky. Seventy seconds later, 43,000 ft high, the dwindling stem of the exhaust expanded into a bright flower. Debris of the exploded rocket and its 388-lb payload fell into the Atlantic, a scant dozen miles from Cape Canaveral. The moon was still beyond the reach of American rocketry, despite eight attempts since 1958.

• The mishap meant the U.S. would be foreclosed from further lunar exploration until 1962, when the first Ranger hard-landing vehicle will fly. But there were more ominous implications: Space systems using the Atlas booster were not faring well. Failures in specific shots appeared to be random, but there was renewed speculation that Atlas' pressurized structure could not withstand the bending loads encountered with lengthy upper stages, though entirely adequate for ICBM purposes.

• Since Atlas is the workhorse booster of both military and civilian space programs for the next decade, its performance is a matter of grave consequence. On its reliability depends the Project Mercury man-in-space program, the AF's Samos reconnaissance and Midas early-warning satellite programs, and such NASA programs as Ranger and Surveyor to explore the moon, the Mariner interplanetary probes, and scientific earth satellites.

• NASA's Marshall Space Flight Center will complete specifications for the new 800,000-lb-thrust second stage (S-II) of the C-2 Saturn launch vehicle in May or June and hold a bidders conference about that time. Proposals will be due in early fall, with Marshall negotiating a development contract early next year. The S-II will be powered by four 200,000-lb-thrust lox-hydrogen engines and should require about three years from the start of development to reach the flight-testing stage. C-2 Saturn should have twice the orbiting capability and three times the lunar soft-landing capability of the C-1, its three-stage predecessor.

• ARPA awarded Convair a $1.9 million contract to build three experimental payloads to be placed in 22,000-mi orbit by NASA Centaur flight-test vehicles beginning early in 1962. Designated Project Arents (ARPA Experimental Test Satellite), the series will gather data on the effects of long-term exposure of materials, components, and subsystems to space conditions, including the outer Van Allen Belt. Items to be studied include plastics, bearings, lubricants, solar cells, storage batteries, and electromechanical devices.

• NASA is scheduled to select a hardware contractor for the Surveyor lunar soft-landing system this month. The choice will be made from among four companies awarded design study contracts last year—North American Aviation, Hughes Aircraft, Space Technology Laboratories, and McDonnell Aircraft. Surveyor will utilize the Atlas-Centaur vehicle, which will be able to inject a gross weight of 2500 lb into a lunar trajectory, of which 800 lb will constitute the payload and structure of the soft-landing "bus" and the balance propellant for the braking rocket.

• JPL will follow the stationary Surveyor lunar observatory with a mobile lunar system called Prospector. It plans to brief interested contractors on Prospector by mid-year, and to request design proposals and award study contracts in the latter half of the year. Hardware development should begin by mid-1963. Prospector is to utilize the C-2 Saturn, which will be capable of injecting 15,000 lb into a lunar trajectory and soft-landing about 5000 lb of dry weight on the moon. The Prospector device itself should weigh about 3000 lb.

• AF has ordered a go-ahead on controversial "Project Needles," the global communication system involving the scattering of huge numbers of half-inch metal dipoles into earth orbit. It awarded North American a $1,844,635 contract to build a 120-ft solid-faced radar antenna at Tyngsboro, Mass., to test the ability of the tiny wires to serve as an artificial ionosphere in the reflection of microwave radio signals. The MIT scheme has been criticized by radio astronomers on the ground that it would grievously impede the operation of big-dish radio telescopes.

• JPL awarded contracts to four companies to study the feasibility of large tracking antennas for control and communication with space vehicles. The studies, due in by late spring, will be performed by Blaw-Knox, Hughes Aircraft, North American, and Westinghouse Electric. Antennas under consideration measure 200–250 ft in diam, and must be held to tighter tolerances than the 250-ft Jodrell Bank instrument to handle the higher frequencies (2300 mc) planned for future lunar and interplanetary spacecraft.

• JPL spokesmen said the new antenna is needed urgently if the planetary and lunar programs now proposed are to be accomplished with dispatch. Compared with the present 85-ft dishes at Goldstone, Woomera, and Krugersdorp, the 250-ft antenna could increase information returned by a factor of 10. Such an increase has unquestionable scientific merit. JPL plans that each of the three stations just mentioned would be equipped with new large antenna within three years.

• AF Ballistic Missile Div. has funded extensive studies by Martin, Convair, and Boeing on the establishing and maintaining of a permanent lunar base.

MAN IN SPACE

• With the solid success of Mercury-Redstone 1 under its belt, NASA moved ahead with plans for an early capsule flight with a chimpanzee aboard. Should that succeed, look for a manned suborbital flight in March or April.

• Even if this schedule can be met (and it is at least four months behind the original timetable projected by former NASA Director T. Keith Glennan), there remains the more critical Mercury-Atlas series to be conducted before the U.S. can achieve its major goal of orbiting a human astronaut. This appears to be at least six months behind the original firing schedule, and Washington observers feel that it will be a close thing to accomplish the orbital mission in 1961, even assuming no new setbacks.

• As a result of the delays, it will cost at least $393 million to complete the Mercury program, and the total could go as high as $500 million if the program cannot meet its present flight-test goals. This was the appraisal of the House Sci-

ence and Astronautics Committee in a progress report which generally okayed NASA's management of Mercury. Regarding charges that Mercury is already obsolete, the committee stated: "Although decisions for the configuration of the capsule and the boosters were made several years ago, technology has not advanced to the extent of overtaking the basic Mercury concept for achieving an early capability of orbiting man in space."

• In an NASA organizational shift, the Space Task Group won its independence from the Goddard Space Flight Center and will now report directly to Abe Silverstein, NASA Director of Space Flight Programs. Presently located at Langley Field, Va., STG has managed the Mercury program since its inception, and last year was assigned responsibility for the three-man Apollo orbital and circumlunar system. It is now expected that STG will soon emerge as the NASA Manned Spaceflight Research Center, at a location yet to be decided.

• In the area of instrumentation and test equipment, a microminiature instrument package that will take 12 measurements of a man under space stresses will be developed by Hughes Aircraft under a $78,000 contract with the AF Flight Test Center, Edwards AFB, Calif. . . . This month, the AF Aerospace Medical Center at Brooks AFB, Tex., receives the spin chair that has been developed for it by Georgia Institute of Technology. The chair is controlled by a computer program.

• The Naval School of Aviation Medicine studies of the effects of spin have led to the general conclusion that unpleasant effects associated with living in a rotating environment have genesis in the semicircular canals of the ear. Concerning the functioning of the semicircular canals, Capt. Ashton Graybiel, USN-MC, speaking at the recent AAAS meeting in New York, remarked as follows: "It has been noted that persons with only slight decrease in function of the canals may not experience visual illusions on moving the head during rotation of 10 rpm (very disturbing rate to most people) and that other reactions are minimal. These subjects had a history of middle ear 'incident' but were unaware of any handicap. The question arises, Is it possible to duplicate these 'spontaneous' reductions in sensitivity by artificial means? That this possibility holds hope for success is seen, for example, in the elective action of streptomycin on the sensory epithelium of the semicircular canals and otolith organs."

• Another suggested use of drugs to condition astronauts came from a team of anesthesiologists of Columbia Univ. College of Physicians and Surgeons. Speaking for the group, at a conference of the New York Academy of Sciences on amine buffers in December, Gabriel G. Nahas reported that tris(hydroxymethyl)-aminomethane, or THAM, has protected dogs from otherwise lethal levels of carbon dioxide in the blood. The Columbia group suggests that THAM may prove a valuable protective for men working in artificial atmospheres. For various technical reasons, THAM has not been successfully developed as an oral drug . . . In the meantime, Hamilton Standard reported a successful 100-hr test of its carbon dioxide remover, which processes air through canisters containing a regenerable solid adsorbent.

• A new trick for protecting man in space has been proposed in the Dynasoar program: Fiber-optic leads to compartments of the vehicle to allow the pilot to evaluate directly the seriousness of fires and the need for ditching.

• NASA's Life Sciences Research Laboratory, established the first of this month at Ames Research Center, Moffett Field, Calif., will have three divisions—Flight Medicine and Biology, Space Medical and Behavioral Science, and Space Biology. The new facility will be opened with the assignment of Richard S. Young as chief of Environmental Biology, the first of a number of branches that will be staffed by some 60 scientists.

SATELLITES

• Space Technology Laboratories won the assignment to develop and build the Orbiting Geophysical Observatory (OGO), a 1000-lb standardized "streetcar" satellite intended to carry up to 50 experiments on a single mission. NASA's Goddard Space Flight Center will negotiate a $15 million contract with STL to deliver three of the craft by 1964. Powered by 70 sq ft of solar cells, OGO will have three telemetry systems, total attitude control by means of gas jets and inertia wheels, and an array of booms for holding experiments away from its central body, which measures 6 ft long and 3 ft square. High-apogee flights are planned with the Atlas-Agena-B, polar orbits with the Thor-Agena-B system, and, later, flights with Centaur.

• AF slipped the 2100-lb Discoverer XIX into a polar orbit with a payload of heat sensors aboard, but no recovery capability. (It was the first non-recoverable Discoverer since No. I in Feb. 1959, though it was the 13th to achieve orbit.) Lasting five days, its instrumentation gathered important infrared data to support the Midas early-warning satellite program. The AF said its sensors were delicate enough to detect the IR reflection of sunlight off a new dime at 1000 yd . . . Discoverer XX, scheduled for launching last month, was to carry more biological specimens into space.

• The first British payload, to be launched in about a year by a Scout vehicle, has been designated International Ionosphere Satellite S-51. It will be approximately spherical, measure almost 2 ft in diam, use four paddles of solar cells for power, and carry four antennas to transmit data at 136-137 mc from a tape recorder upon ground command. Instruments will include an electron-density gage by Birmingham College, an ion mass spectrometer by University College in London, and a cosmic-ray detector by Imperial College, London.

• Army may have outfoxed itself in the design of the Courier delayed-repeater satellite, according to one line of Pentagon thinking. Courier IB was supposed to operate for one year (with a 10 per cent duty cycle) but it performed less than three weeks. Indications are that the carefully contrived code for commanding Courier was just too clever. Though the Army refused to comment, it appeared that the satellite's stubborn refusal to respond to ground commands was the result of a breakdown in its elaborate triggering sequence.

• As one of his last acts in office, President Eisenhower warmly endorsed the NASA program to develop low-orbit active-repeater satellites suitable for commercial communications. "The government should aggressively encourage private enterprise in the establishment and operation of satellite relays for revenue-producing purposes," Ike declared. His directive spotlighted the keen interest of the common carriers in exploiting communication satellites and, though it could not bind President Kennedy, put the government on record against

public operation of the relay satellites.

SPACE SCIENCE

• The batteries of the Explorer VIII ionospheric direct-measurement satellite expired Dec. 27, 54 days after it was injected into orbit by a Juno II rocket. A useful lifetime of 60–90 days had been forecast for the 90-lb satellite. More than 700 mi of magnetic tape was used to record the information transmitted by Explorer VIII, including data gathered during the great solar storm of Nov. 12. A preliminary discussion of Explorer VIII's finding is expected shortly from NASA.

• The solar storm of Nov. 12 sharply increased the density of the earth's upper atmosphere, according to Robert Jastrow, chief of the Theoretical Div. of NASA's Goddard Space Flight Center. Drag encountered by the 100-ft Echo-I balloon satellite approximately doubled, increasing the satellite's orbital period about two seconds a day for a period of several days before returning to the previous level. Atmospheric heating by solar particles is believed responsible for the increase in atmospheric density at the altitude of Echo I, currently orbiting with an apogee of 1334 mi and a perigee of 619 mi. The heating causes a slight upward expansion of the atmosphere at low levels, and a consequent large increase in density at high.

• Next fall is the target date for launching Stratoscope II, the most ambitious balloon astronomy project now underway. Object is to hoist a 4300-lb payload, including a 36-in. reflecting telescope, to an altitude of 80,000 ft, where it will photograph the sun, Saturn's rings, the cloud cover of Venus, the mysterious Red Spot of Jupiter, and the thin gaseous nebulae between the stars. Project director is Princeton's Martin Schwarzschild, who also directed the highly successful Stratoscope I program in 1959, which obtained the finest sun photos ever made. Project sponsors are the Office of Naval Research and the National Science Foundation.

• The space between the earth's surface and the lower reaches of the ionosphere acts as a giant resonant cavity, according to scientists of MIT's Lincoln Laboratory, who have detected and measured a low-pitched hum emitted by this region when excited by lightning. Balser and Wagner of Lincoln Lab determine the fundamental natural frequency to be 7.8 cps. This finding confirms a prediction of W. O. Schumann, German physicist, made a decade ago.

• Physicists S. D. Softky and R. K. Squire of Stanford Research Institute and UC-Livermore, respectively, propose relativity theory be tested by exploding a nuclear device 100,000 mi from earth and measuring the return time of light, X-rays, gamma rays, and radio waves. Differential return times would fell a part of the theory.

• Activation analysis, involving bombardment of an unknown material with neutrons and analysis of the induced secondary emissions to identify the material's constituents, has become a practical research tool, according to V. P. Guinn of Shell Development Co. Equipment for activation analysis has been proposed for planetary landing vehicles.

• A Javelin rocket carrying the first rubidium-vapor magnetometer to be used in a space probe was launched by NASA from Wallops Island in December and reached an altitude of 717 mi, telemetering a continuous report of variations in the earth's magnetic field along its full course. Built by Varian Associates, the rubidium-vapor magnetometer will also be used in deep-space probes.

• AF Cambridge Research Center will have Ozarc sounding rockets launched from aircraft over the Pacific to make synoptic meteorological measurements.

• The dust belt detected by Explorer I may be controlling proton radiation in the inner Van Allen Belt, theorized S. Fred Singer of the Univ. of Maryland. Hermann Schaefer discusses proton radiation in space on page 39.

MISSILES

• A SAC crew launched an Atlas ICBM from a horizontal "coffin" site at Vandenberg AFB, Calif., and dropped its nose cone into Eniwetok lagoon, a distance of 5041 mi. A TNT charge in the re-entry body enabled the submarine cables and hydrophones of the Pacific Missile Range to get a precise fix on the point of impact. The shot was conducted by the 576th Strategic Missile Squadron, which maintains the Vandenberg Atlas alert and trains crews for other Atlas bases.

• AF has developed an underground radio control link for its Minuteman ICBM squadrons which may save about $120 million on the fixed-site portion of the program. The new system involves radio waves which travel along the surface of the ground to each silo, eliminating the need for cable at a cost of $25,000 a mile. The airmen figure they can save about $300,000 for each buried Minuteman, beginning with the fourth squadron. About 400 Minuteman silos may be equipped with the system.

• The Army canceled the SD-4 surveillance drone, under development by Republic Aviation. Designated Swallow, the drone project was dropped after an expenditure of $34 million because of a "re-evaluation of the increasing costs of this system and the desirability of applying the related funds to other projects," the Army said. It was the second drone loss for Republic. Two years ago, the Army killed the SD-3 pusher-propeller all-weather drone system which the company was developing for battlefield use. The latest action left the Signal Corps with two active drone projects: The short-range SD-2 propeller model, being developed by Aerojet-General, and the long-range SD-5 jet-propelled drone, being developed by Fairchild Engine & Airplane Corp.

• Nike-Hercules will replace the Nike-Ajax anti-aircraft missile at 18 metropolitan and air-base areas of the U.S. beginning this summer, the Army reported. A total of 68 Ajax sites will be terminated in such areas as New York, Washington-Baltimore, Los Angeles, San Francisco, Cleveland, Detroit, Pittsburgh and Philadelphia. Because Hercules has three times the range and more than twice the altitude capability of Ajax, plus the ability to carry a nuclear warhead, one Hercules battery can replace several Ajax batteries with no loss of defensive capability, the Army said.

CONTRACTS

• Martin-Orlando will continue development of the Pershing field ballistic missile system under an Army contract for approximately $77 million that runs through July 31, 1961. Bendix received $20 million from the Army for the same period to cover Pershing inertial guidance development . . . GE's Defense Systems Dept. received $23.5 million from the AF to cover previous letter contracts authorizing GE work on Atlas radio-command guidance and associated instrumentation for AF satellites and the Atlas and Titan

missile programs . . . In the Titan program, RCA Service Co. received a multimillion dollar contract from Martin for installation and checkout of ground equipment at Beale AFB, Marysville, Calif. . . . The AF Ballistic Missile Center awarded five contracts totaling more than \$12 million to GD's Stromberg-Carlson Div. for communication systems for Titan bases . . . GE's Ordnance Dept. received a Navy letter contract for \$34 million to design and fabricate the advanced Mk 84 fire-control system for Polaris submarines; first to receive the digital-computer system will be the USS Lafayette . . . Hughes Aircraft will continue production through 1961 of Polaris missile inertial-guidance equipment under a \$6 million Navy contract bringing their total on the project to \$21 million . . . GE's Missile and Space Vehicle Dept. will build and test airframes for the Army's surface-launched free-flight rockets and Automet test vehicles under a \$1.6 million Army contract; these vehicles are designed to test components and systems for possible use in future weapons . . . Chrysler will maintain Jupiter missile training equipment at the AOGM School, Redstone Arsenal, under a \$1 million Army contract.

MATERIALS

• Heat-storage materials for solar thermionic power systems will be explored by GE's Missile and Space Vehicle Dept. under a \$200,000 NASA contract running for eight months; silicon is a typical material to be investigated . . . General Vacuum Corp. will design and construct a large furnace for GE's Metals and Ceramics Laboratory (Schenectady) that will give temperatures above 4500 F in a zone over 1 ft in diam and 2 ft high and operate at pressures around 10^{-6} mm Hg . . . Mathematical studies and corroborative tests of the performance of composite plastic structures for re-entry bodies and rocket nozzles will be the subject of an Aerojet-General Plastics Branch program for the WADD Nonmetallic Materials Laboratory . . . Rensselaer Polytechnic Institute will establish an interdisciplinary materials research program under an NASA grant of approximately \$300,000 a year. Rensselaer received over \$1 million in other government and industry grants for materials research in 1960.

• 3M says its Pluton, an organic fiber, withstands temperatures of 18,000 F without melting of charring, and will be evaluated in a phenolic-resin laminate for nose cones, nozzles, and other space-vehicle structures . . . The Materials Laboratory of WADD is investigating ferrocenes, a class of metallo-organic compounds that show high thermal stability, for possible use as protective coating for satellites and space vehicles. This Laboratory is also actively exploring polyurethane foams for micrometeorite protection and on-the-spot "minute" constructions of space hardware . . . Armour Research will conduct an 18-month, \$460,000 study of factors that influence the fracture of nonmetallic ceramics for WADD's Material Controls Div.; the study will be concerned mainly with single crystals and multicrystalline forms of magnesia and alumina; but titanium oxide, titanium carbide, and lithium fluoride will also be explored.

• A compound of manganese, antimony, and chromium being studied by W. H. Cloud and H. S. Jarrett of Du Pont develops magnetic properties when heated; chromium controls transition temperature, which can be between 0 and 373 K . . . Battelle has released previously unpublished information on the superalloy WI-52, a cobalt-chromium-tungsten developed for gas-turbine components operating in the 1000–2000 F range . . . Titanium diboride is being produced by National Carbon Div. of Union Carbide as a powder and fabricated shapes . . . NRL will attempt to extend the use of zinc coating to protect tungsten, as it has been found to do niobium, at high temperatures in an oxidizing atmosphere.

• Kodak's "Irtran 2" transmits more than 70 per cent of incident energy from 2.5 to 10 microns through 2-mm of the material, according to the company, and has excellent physical properties for use on lenses, domes, prisms, flats, and windows in space vehicles and various infared instruments . . . General Instrument Corp. is studying the production of electricity thermoelectrically from unrefined fission products under contract to the AEC.

• Special coatings allow two or more copper components, or copper and certain alloys, to be joined with a homogeneous bond that retains virtually all of the electrical and thermal conductivity of copper, according to Chase Brass and Copper.

MISSILE DEFENSE

• When British news media uncovered the story in December of how radar reflections from the moon, detected at the Thule, Greenland, BMEWS station Oct. 5, resulted in a missile scare at SAC and NORAD Hq, they also forced SAC to release what until then had been some very closely held information about BMEWS capabilities. The information, revealing to some degree the detection capability of the system, and especially the implied capability of detecting the flight of even a single missile, as well as the effective and very rapid warning of an attack.

SPACE QUOTES

• President Eisenhower in his last budget message: "Further testing and experience will be necessary to establish whether there are any valid scientific reasons for extending man-in-space flight beyond the Mercury program." His budget proposed curtailment of Project Apollo. . . In his farewell address to the nation, President Eisenhower sounded this warning: "Only an alert and knowledgeable citizenry can compel the proper meshing of the huge industrial and military machinery of defense with our peaceful methods and goals, so that security and liberty may prosper". . . Two recommendations of an advisory report to President Kennedy on the U.S. position in the space race: "Establish a single responsibility within the military establishments for managing the military portion of the space program. . . Establish the organizational machinery within the government to administer an industry-government civilian space program". . . From Lt. Gen. B. A. Schriever, ARDC Commander, addressing a recent technical meeting: "I am concerned that the importance of satellites and other space systems as essential elements of our military strength is not fully appreciated. . . Martin Co. President William B. Bergen before an educational forum of the New York Society of Security Analysts: "Defense business is big business. . .a big market. The contractor who knows that he can service a part of it better than anyone else can count on a stable or rising business. He can, to a great extent, control his own destiny. He should be able to earn a reasonable profit. He even has an advantage over the average business, for he is sheltered to some extent from the fluctuations of the business cycle." ♦♦

For the record

The month's news in review

Dec. *1*—Soviet Union orbits second 5-ton spacecraft carrying two dogs, Pchelka and Mushka, other animals, and biological specimens.

—Army claims successful initial test of complete Nike-Zeus guidance system.

—11 West European countries agree to form planning unit on joint space-research agency.

Dec. *2*—Soviet spacecraft burns up in earth's atmosphere as re-entry attempt fails.

—AF elated over unexpected "priceless scientific dividend" from Discoverer XVII: Human tissue cultures aboard were exposed to a "gigantic" solar flare.

Dec. *4*—Project scientist states that neurospora returned from 1180 mi in space in Sept. 19 NERV shot were recovered in a state of "physiological death."

—NASA attempt to orbit satellite with four-stage Scout rocket fails.

—American Bar Foundation advises delay in drafting of international space law code.

Dec. *5*—Snark bows out with 5000-mi flight.

—Pres. Eisenhower presents Collier Trophy for achievement in aeronautics or astronautics to the AF, Convair Div. of General Dynamics, and Space Technology Labs.

Dec. *7*—AF orbits Discoverer XVIII.

Dec. *8*—AF discloses it is developing a passive communications satellite.

—Italian Continentale News Agency reports 100 persons, including three top missile experts, were killed Oct. 21 in explosion of a new Soviet rocket. The three experts cited as killed were Air Marshal Mitrofan I. Nedelin, chief of Soviet missile forces; Gen. O. Nikolai O. Pavolovsky, deputy chief of staff; and Prof. Dmitri V. Efremov, deputy chairman of the Russian atomic energy committee.

Dec. *9*—AF flight-tests X-15's new ball-shaped "hot nose."

Dec. *10*—AF plane snares Discoverer XVIII capsule in mid-air; human cells aboard reported unaffected by space radiation.

Dec. *12*—Army scores success in initial flight test of new Pershing guidance system.

Dec. *14*—AF B-52G completes record 10,000-mi nonstop flight without refueling in 19 hr 45 min.

Dec. *15*—Atlas-Able lunar rocket—last in a planned series—explodes at 40,000 ft over the Atlantic, putting scoreboard for lunar attempts at "0."

—British Government offers its Blue Streak as basis of joint space program for West European nations.

Dec. *18*—NASA plans 250-ft-diam antennas for tracking spacecraft.

Dec. *19*—NASA unmanned Mercury capsule weighing about 2400 lb is propelled 235 mi out into Atlantic Ocean by Redstone booster, and recovered intact.

Dec. *20*—AF launches Discoverer XIX into polar orbit.

—AF Titan drops into Atlantic after second stage fails to ignite.

Dec. *25*—United Technology Corp. successfully static-fires first large trial segmented solid-propellant rocket engine.

Dec. *27*—Explorer VIII stops transmitting as batteries run out.

Dec. *29*—NASA Administrator T. Keith Glennan resigns, effective Jan. 20.

—SPASUR reports Discoverer XVII burned up as it re-entered earth's atmosphere

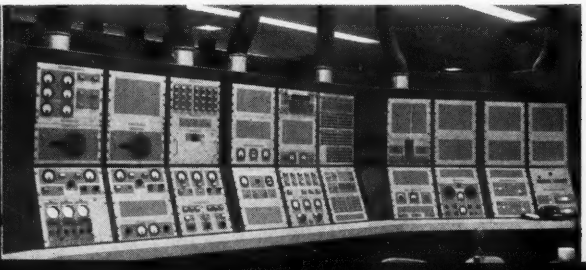
Dec. *30*—NASA reports solar flares in recent weeks caused abrupt losses of Echo I's orbital momentum.

Azusa II in Operation

Azusa I, the precision missile tracking system at Cape Canaveral since 1954, retires this year, to be replaced by Azusa II, a successor also designed and built by Convair-Astronautics for the Air Force. Azusa II will track missiles fired down the Atlantic Missile Range and predict impact points. In addition, according to Convair Vice-President James R. Dempsey, the system could be used to calculate satellite rendezvous points, track orbiting space vehicles, and determine satellite-to-satellite interception points.

Technically, the Azusa II system increases accuracy by 10 parts per million in direction cosine and 10 ft plus 5 parts per million in range—to 0.2 part per million in direction cosine and 0.1 ft, respectively.

Left, Azusa II battery of radome-clad antennas at Cape Canaveral; right, control room of the $10-million facility, designed by Convair-Astronautics for the Air Force to replace the well-known Azusa I.



Careers in astronautics

By Irving Michelson, *Illinois Institute of Technology*

SEVERAL months ago, Congress requested a comprehensive review of current and projected space programs prepared by industry with the aid of NASA and the military. The two Congressional Space Science Committees solicited views on 10 specific aspects of astronautical development which seem to have been carefully and well chosen. In addition to their prime interest from the technical viewpoint, industry reaction will likely foreshadow important revisions in over-all program planning which will be of particular importance to engineers and scientists throughout the nation.

High on the list of questions put to industry is one dealing with the application of atomic energy to space boosters, not only with regard to the Rover nuclear-rocket engine presently under development, but also with respect to the broad field of nuclear-powered vehicles in general. On this question and others, the two Congressional Committees have sought not only the views of the several sponsoring agencies and the contractors they have selected, whose views are not surprisingly correlated with their own, but also the opinions of those who have made proposals in this area which have not been supported. By opening up the discussion in this manner and inviting answers from all those qualified to supply information, many fine, and unexpected, views may come forward. Certainly this type of appeal should produce more in the way of ideas than has been customary in the past.

* * *

Returning to the question of nuclear rockets in particular, we recall particularly the glowing picture presented by the Douglas engineers, who even offered estimates of cost for flight operations to the Moon. This group can naturally be expected to plead its case for nuclear rockets eloquently before Congress and to seek a major role in future programs. Rocketdyne, of course, is also a leading contender in this field, having been involved in early work on the Rover program and enjoying as it does a unique position in developing liquid rockets for space propulsion. Other companies are also preparing vigorous programs in nuclear-rocket development, and urging a competitive atmosphere for development of a concept which would in many instances be competitive with liquid-propulsion systems. At the same time, many companies are establishing themselves in a variety of nuclear-propulsion specialties which could mushroom once the basic concept is accepted. One of these is the Sylcor Div. of Sylvania, which is developing new fuel element materials and designs, both from the metallurgical and mechanical engineering viewpoints. Meanwhile, physical chemists at United Aircraft research labs are studying nuclear power-cycle concepts for auxiliary space-power units, and looking for help from the chemical engineers.

* * *

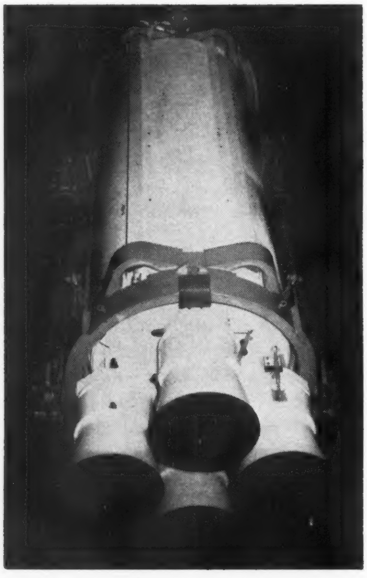
Another aspect of space-vehicle design on which Congress has called for opinions from industry is the long-standing question of the relative merits of solid and liquid rockets, especially with regard to their use as boosters. Attention is being focused on reliability, cost, and other factors which can now be better evaluated as a result of accumulated design and limited operational experience gained in the past three years. Within the next fiscal year, in any case, it seems fairly certain that over-all enthusiasm for Minuteman will benefit the cause of solid fuels, since budget estimates extend to about $1 billion for this program alone in the coming year. Somewhat as a byproduct of the interest in solid fuels, various hybrid configurations will continue to receive attention—the more so as this is another of the areas singled out by the Committees.

* * *

Weather satellites have been studied by Rand Corp. from the standpoint of the social impact of space research, evaluating the economic effects of hurricanes and the benefits to air cargo operations, and predicting great economic potential for improved weather forecasting techniques generally. NASA and the Weather Bureau appear much gratified by the successes to date, and have declared for substantially expanded efforts in related areas. Instrumentation, communications, and data-reduction systems and techniques will be of particular importance in this respect. These developments provide additional impetus for work in all branches of meteorology through the vastly improved observational data supplied thereby. Oceanographers will probably also seize upon these advances in order to gain better understanding of the physical processes which determine ocean movements. An integrated, semi-automated, high-speed weather system covering an important segment of the Atlantic states and also the adjacent ocean regions, has already been established, and United Aircraft's Weather System Center is seeking methods to test and evaluate techniques and equipment for weather observation and data handling.

For specific career opportunities this month see second and back covers, pp. 13, 56-57, 61, 69-72, 75, 81, 85, 90, 93 and 96. ♦♦

Ready for Flight



Loaded second-stage motor for the Air Force Minuteman ICBM moves on a dolly out of the final-assembly building at Aerojet-General's solid-rocket facilities in Sacramento, Calif., ready for the missile's flight-testing program.

NASA's Marshall SFC Develops Facilities

With the major portion directly related to the Saturn program, facilities costing roughly $70 million have either been completed recently or are in progress of contruction at NASA's George C. Marshall Space Flight Center in Huntsville, Ala.

International scene

By Andrew G. Haley

A space Research Symposium, sponsored by the government of Argentina and presided over by Teofilo M. Tabanera, was held at Buenos Aires, Nov. 28–Dec. 3. A surprisingly large and distinguished group of U.S. scientists participated in the Symposium.

The sessions were convened by the Secretary of State for Aeronautics, Brigadier Ramon Amado Abrahin, and addresses at the opening Plenary Session were given by Prof. Tabanera, Hugh L. Dryden, Deputy Administrator of NASA, and Richard W. Porter, Vice-President of COSPAR. Following the opening ceremonies, all delegates were introduced to the President of the Argentine Republic, Arturo Frondizi. Addresses were given at the following Plenary Session by Andrew G. Haley, Luiz de Gonzaga Bevilacqua on behalf of the Brazilian Interplanetary Society, and Aldo A. Cocca on behalf of the Argentine Interplanetary Society. Papers presented by U.S. delegates from the United States included: Taylor A. Chubb, NRL, "Measurement of Ultraviolet and X-Ray Radiations above the Earth's Atmosphere"; Hugh L. Dryden, "General Aspects of the NASA Program for the Development of Rockets for Use in Space Vehicles"; Fausto G. Gravalos, GE, "Supersonic Aerodynamics"; Andrew G. Haley, "Outline of Program for Astronautical Communication"; R. P. Haviland, GE, "Survey on Space Communications"; Charles Y. Johnson, NRL, "Aeronomic Measurements"; John T. Mengel, NASA, "Satellite Tracking"; Donald H. Menzel, Harvard College Observatory, "The Technique of Stratospheric Balloons and Space Research"; Homer Newell, NASA, "Rocket Sounding of the Upper Atmosphere"; Richard W. Porter, NAS, "International Collaboration in Space"; William A. Rense, Univ. of Colorado, "Solar Ultraviolet Radiations and its Effects on the Earth's Upper Atmosphere"; Alan H. Shapley, NBS, "Ionospheric Irregularities Studied by Satellite Radio Beacons"; Martin Summerfield, Princeton Univ., "Research in Solid-Propellant Rockets"; Harry Wexler, Weather Bureau, "Interpretation of Observations Received from Meteorological Rockets and Satellites."

The most important international action was the organization of the Provisional InterAmerican Committee for Space Research. The "Declaration of Buenos" was adopted after several days' discussion, and the members whose signatures are affixed have decided to constitute a Provisional InterAmerican Committee for Space Research for these purposes:

(1) To promote the formation of local committees or organizations of non-governmental nature, in the different countries, the members of which should be chosen from natural and social scientists and engineers whose activities are connected with space science and technology.

(2) The aforementioned organizations will keep in touch with each other through the Presidency of the InterAmerican Committee for Space Research (ICSR).

(3) The Committee will endeavor to organize the regular sending of all available information to each of the local organizations, according to the different subjects or branches of technological or scientific activity.

(4) One of the objectives of the local organizations will be the establishment of National Commissions or the attainment of Government support in order to secure a greater activity in space research.

(5) Frequent local meetings should be organized by the Inter-American Committee which would be limited to specific subjects, and attended by a few foreign scientists and technicians.

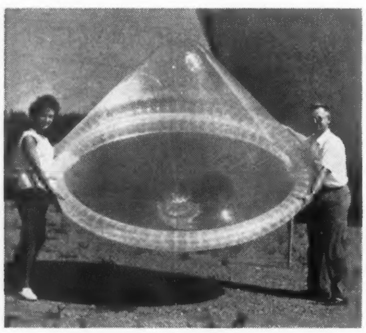
(6) Periodic bi-lingual publications will be another objective of the Committee; they will comprise abstracts of papers connected with space science and technology.

(7) The local organizations will promote the study of the different disciplines connected with space science and the formation of space research programs in research centers and universities.

(8) Teofilo M. Tabanera is hereby appointed as President of the Provisional Committee; R. W. Porter as Vice-President (North America) and Luis de Gonzaga Bevilacqua (South America); and A. G. Haley, Vice-President for IAF affairs. The president is empowered to appoint a person from his own country to serve as secretary. New officers will be elected when the Provisional Inter-American Committee for Space Research is replaced by a permanent InterAmerican Organization.

The complete Provisional Inter-American Committee for Space Research is composed of the following members: Aldo A. Cocca and Teofilo Tabanera, Argentina; Narayan Nerurkar, Bolivia; Luis de Gonzaga Bevilacqua and Ricardo Palmeira, Brazil; Andrew G. Haley, IAF; Richard W. Porter and Martin Summerfield, USA; Jose Edwards, Chile; Hector Fernandez Guido, Uruguay; Ronald Woodman, Peru. ♦♦

Space Power Trend

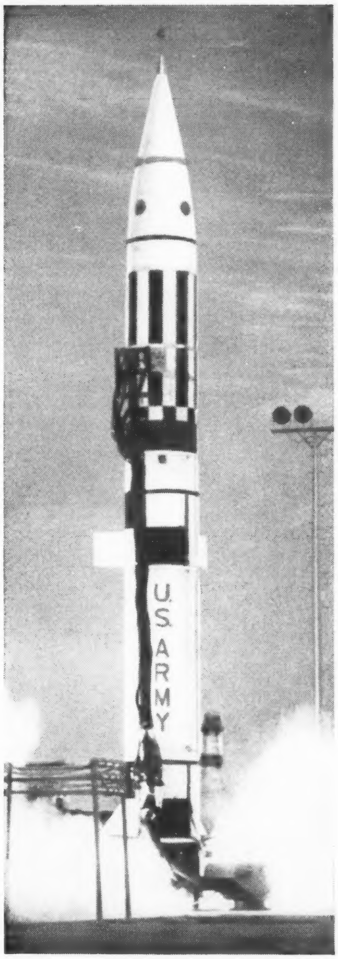


This parabolic reflector, static-testing forerunner of models for power sources on satellites, illustrates the versatility and growing application of inflatable structures for space projects. Being developed by the G. T. Schjeldahl Co., the metalized mylar reflector is 7 ft in diam when inflated, weighs less than 1/2 lb, and before inflation fits into a canister the size of a coffee cup. Rim toroid takes 5 psi; area between back and lens, 0.01 psi.

European Meetings on Rockets, Space Technology Planned

Two European meetings devoted to sounding rockets and space technology are being planned for late spring. The British Interplanetary Society is organizing a European Symposium on Space Technology, June 26–28, to consider the joint participation of Western European nations in space technology, while the French Astronautical Society, in cooperation with BIS and the Italian Rocket Society, is setting up a Sounding Rockets Colloquium in Paris, June 23–24.

Additional details concerning the meetings programs will be forthcoming in the near future. —A. K. Oppenheim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Today the state-of-the-art in liquid propulsion is advancing more rapidly than ever before. Thrust modulation, restart capability, packaged engines and other advanced concepts are appearing in operational systems. Manned vehicles and huge, booster systems are being planned and developed; hybrid, slurried, gelled and encapsulated propellants are being evaluated.

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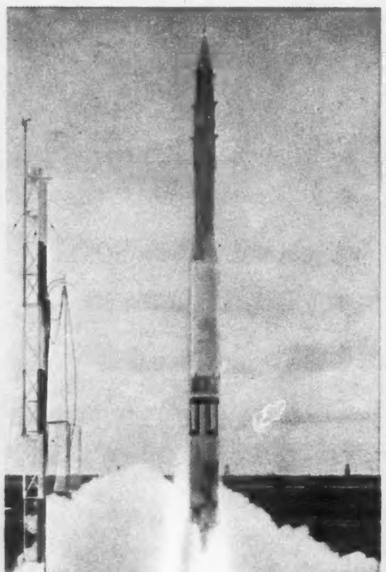
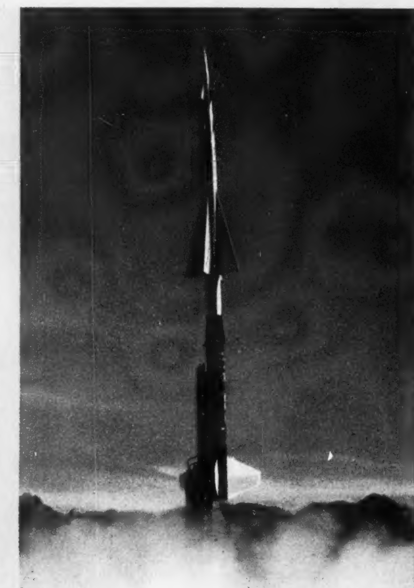
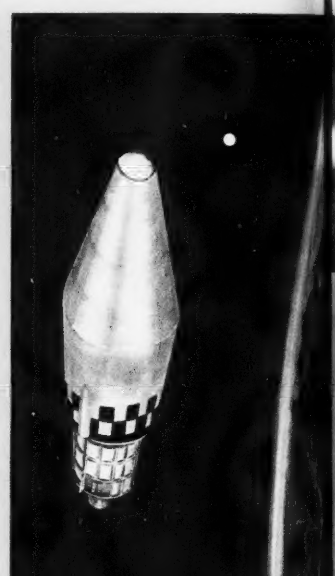


Vanguard



Nike Ajax



Agena A and B

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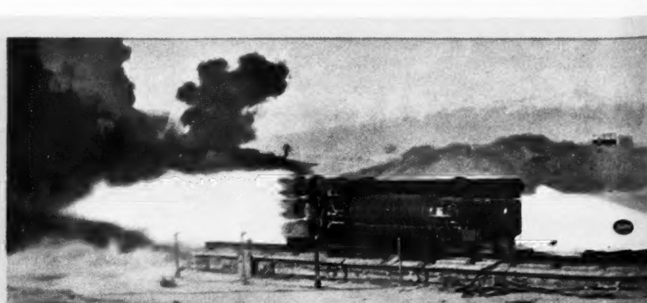
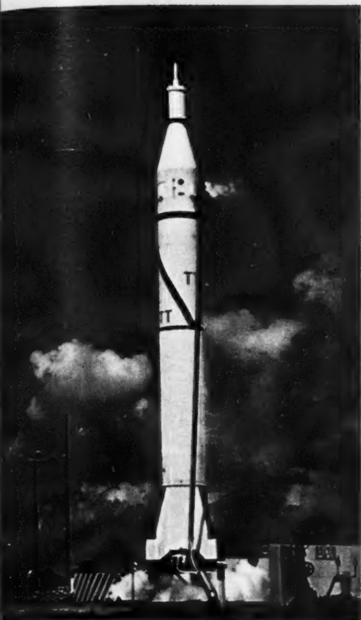
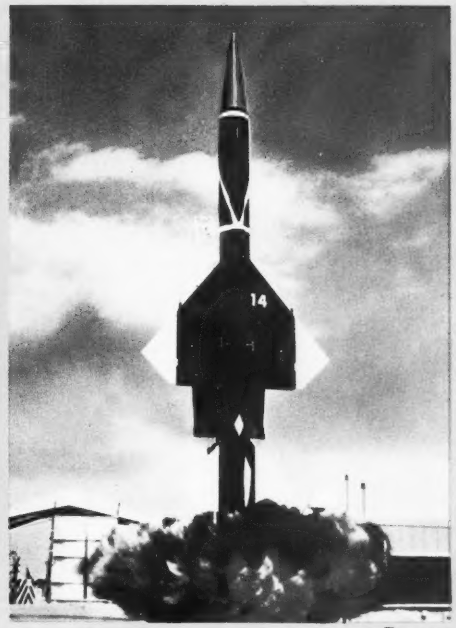


Rocket Sled



Jupiter-C



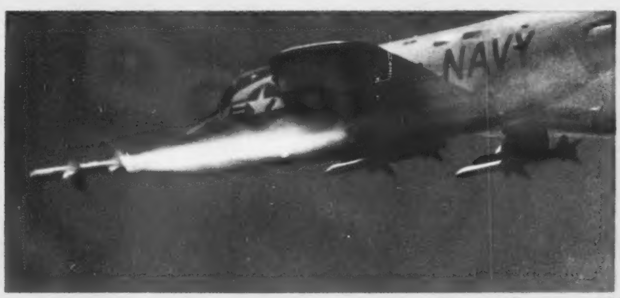
Bomarc

Able and AbleStar Stages

Rascal

Bullpup

Experimental Manned Aircraft (X-IE)



Sparrow III

Photos: Courtesy U.S. Army, U.S. Air Force, NOTS, Bell Aircraft Co., Boeing Airplane Co., Coleman Engineering, Douglas Aircraft Co., Inc., Lockheed Aircraft Corp., Martin Co., Thiokol/Reaction Motors

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In print

The Manned Missile: The Story of the B-70 by Ed Rees, Duell, Sloan and Pearce, New York, 1960, 182 pp. $3.50.

Never before has a single airplane (that has yet to fly) created the uproar that attends discussion of North American's B-70 manned-bomber project. Because of conflicting high-level decisions on this vital effort, there has existed a great need for a clear and incisive report on the B-70 to the public. Unfortunately, this book by Ed Rees falls considerably short of achieving this goal.

Mr. Rees, as senior military correspondent for *Time*, is eminently qualified to write on military matters. It is therefore, discouraging that "The Manned Missile" makes such heavy use of cliches and parables as this: "As a weapon, it would be virtually invulnerable to enemy offensive measures since its quick-reflex capability would get it off the ground well before enemy nose cones would arrive to blow up its airfields; and it would be equally invulnerable to enemy defense because of its great speed and altitude."

How anyone could describe a manned bomber of Mach 3 and 80,000-ft capability as "invulnerable," especially when it cannot become operational for several years to come, is astonishing, and almost unbelievable.

Mr. Rees presents information on the B-70 that is excellent; he writes with obvious competence on the airplane itself. Beyond this area, however, the value of the book becomes questionable.

There is every indication that this is an effort hastily assembled in order to reap the publishing reward of having the book in the stores while the B-70 is still "hot news." Mr. Rees commits a series of errors of fact which bring the reader to question his authenticity, and the adequacy of his research.

Mr. Rees states, for example, that the B-70 is the only new military airplane under development. This is not so, and many aeronautical engineers working on existing projects will doubtless be surprised to learn of the author's conclusion.

The largest non-nuclear bomb used in WW II did not weigh 11,000 lb, but 22,000 lb. The Bomarc-B missile has not been scrapped; it is still very much alive. The Hiroshima atomic bomb was not of 13-kiloton yield, but of 20-kilotons. Mr. Rees, in describing the launching of Explorer I to join Sputnik in space, seems to have misplaced Sputnik II, launched on Nov. 3, 1957. Vanguard did not blow up on its launching pad at Cape Canaveral "two months after" the orbiting of Explorer I; Vanguard TV 3 exploded on Dec. 6, 1957—nearly two months before the launch of Explorer I.

Intriguing also is Mr. Rees' statement that the Army has placed a squirrel in orbit. Since he refers to this as accomplished fact, it should create quite a stir in missile/astronautics circles. And it was not Lunik III that impacted on the moon, but Lunik II. The GE J-93 jet engine of 30,000-lb thrust is not the world's most powerful; the British Olympus engine, scheduled for STOL and VTOL projects, has for some time delivered 33,000 lb of thrust. There are more in the same vein.

The case for the B-70 is emphasized by Mr. Rees, but he fails to do it justice by creating as arguments hypothetical situations that can be shot as full of holes as the impregnability of Singapore or the unsinkability of the battleship. Mr. Rees, for example, compares (on page 59) the reaction time of the Soviet defense system to the speed of the B-70, and concludes that "it would take seven minutes for the Soviet defense network to respond . . ." Response in this instance is specifically manned fighter planes. Continuing his trend of thought, Mr. Rees makes the incredible statement that "the B-70 would be exposed to actual fire for a total of about two minutes in and out of the target area." Mr. Rees, of course, pre-supposes initial detection off Leningrad, and seems to forget in this area that by the time the B-70 could become operational—"if we proceed with the B-70 program full speed ahead we wouldn't get it, I would say, until *1967*," stated Gen. Nathan Twining—Soviet defense systems might be expected to improve enormously and extend their detection time while reducing their reaction time.

Mr. Rees started out to fulfill the very real need for a competent book to explain the B-70 and all its ramifications. The excessive factual errors, and the questionable logic employed to depict use of the B-70, have prevented his reaching his goal.

—Martin Caidin

The Exploration of the Solar System by Felix Godwin, Plenum Press, New York, 1960, 195 pp., illustrated. $6.50.

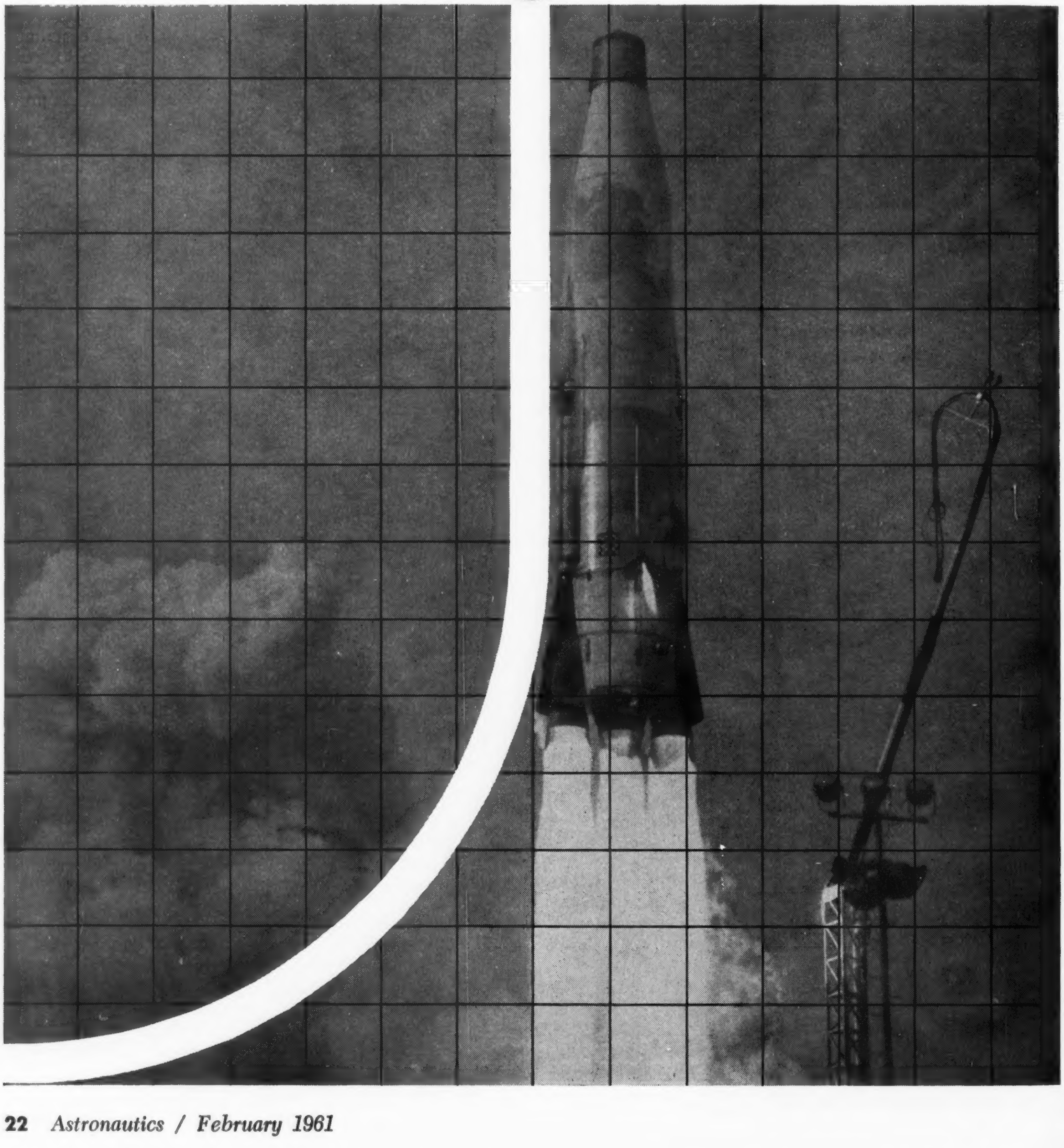
This is an interesting book for several reasons, among them the fact that the author is a rather young man (compared to this reviewer, at least!) still attending college and without any specific rocket or missile experience, who, in five chapters and seven appendices, has brought together some fresh ideas on exploration of the moon and the planets. Unburdened by any moss-covered, preconceived notions, the book shows an approach to space technology that goes beyond what one would expect even from a thoughtful person as yet unsoured by the realities of the space business.

The author begins with a good, sound statement in his first chapter on "The Assembly Orbit" which notes that "no space ship of reasonable dimensions using foreseeable means of propulsion could ascend from the earth's surface and land on the surface of another world without intermediate refueling." He is correct in the sense that no propulsion system or vehicle now under development (and I presume he means *manned* space ship) could send a man to the moon or one of the planets and return him to earth without refueling. What Godwin fails to realize, however, is that orbital assembly and refueling may prove even more impractical than building and launching large vehicles such as Nova (whatever that may be).

Commendably, the author wastes no time adding to the vast body of ill-informed speculation as to what the Russians will do next and instead proceeds in the next several chapters to an analysis of landings on the moon, Venus, Mars, and the more distant planets.

Here, almost for the first time, we find an author who has carefully studied some of the life-science and civil-engineering problems facing future astronauts. Godwin proposes the use of a modified blimp or other small airship for cruising about in the Martian and Venusian atmosphere—an idea of considerable merit, since the buoyancy of such craft could be adjusted to the atmosphere. However, it is amusing to see the phrase "air scoop" used in the blimp diagrams, since I suspect there would be precious little

(CONTINUED ON PAGE 89)



Astronautics FEBRUARY 1961

New ARS Standing Committees

At the Board of Directors Meeting in Washington on December 8, four new standing committees were created in recognition of the expanding interests of the Society—the Education Committee, the Section Activities Committee, the International Affairs Committee, and the Public Education Committee. As the technical committees foster and supervise the scientific and technical activities of the Society, the standing committees provide a similar service to what can be termed our business affairs.

Education Committee. The committee will be chaired by Prof. Ali Bulent Cambel of Northwestern Univ. The Board felt that the Society should take a more active interest in the education standards of university curricula applicable to the various fields of astronautics. This particular function can be handled more effectively by changing the committee's status from that of a technical committee to that of a standing committee. Probable need for advice or assistance from technical committees is recognized.

Section Activities Committee. Effective operation at the grass-roots level is essential to ARS as it is to all organizations. The problem of supporting Section activities has in the past been the responsibility of the Membership Committee, which has effected many improvements over the years. The Board, acting upon the recommendation of an ad hoc committee formed to study means of improving national support to the Sections, established the Section Activities Committee, now under the chairmanship of William J. Cecka Jr. of Rocketdyne.

International Affairs Committee. In recognition of the fact that astronautics is a worldwide activity, the International Affairs Committee was created and charged with the responsibility of effecting closer cooperation and liaison between the ARS and foreign and international societies interested in the exploration of space. Prof. A. K. Oppenheim of the Univ. of California has consented to serve as the committee's chairman.

Public Education Committee. Members of ARS are fully aware that effective exploration of space is a task requiring tremendous efforts extending over the next several decades. Our bylaws recognize the need for keeping the American public informed of this fact and for obtaining public support by the statement: "It (the American Rocket Society) shall also recognize an obligation to communicate the value, significance, and importance of rocketry and astronautics to the nation at large." To discharge this responsibility, the Public Education Committee was organized under the chairmanship of Arthur Kantrowitz of Avco-Everett Research Laboratory.

Harold W. Ritchey
President, American Rocket Society

ARS Annual Meeting Addresses

Danger signs in higher education

A scientist-educator sees the need for direct Federal support for higher education to combat low staff salaries, undue emphasis on consulting and contract-getting, and inadequate support of non-science subjects

By Martin Summerfield

PRINCETON UNIVERSITY, PRINCETON, N.J.

The United States today is beset by many challenges—technological, political, military, economic—in a multitude of areas. We in the ARS are concerned especially with the challenge in space, both in weapon systems and in space research, and as engineers and scientists we are doing a fairly good job of helping to meet that challenge. But the challenge in the area of education, less immediate though it may be, strikes directly at our right to survive in the future as a first-rank nation. Our future leadership will emerge from the higher educational system that we have today, and our future position as a nation will depend on that future leadership. The present state of higher education, therefore, requires the earnest attention of our foremost citizens.

In a manner of speaking, I began to prepare this talk two years ago, when I decided to undertake some foreign travel to get to see ourselves as others see us. Since then, I have engaged my foreign friends in discussions about the U.S. and about other

The generals, the government, and Goliath

A scientist-businessman stresses the need for closer military-government-industry cooperation to assure maximum utilization of our great scientific and technological capability in the fateful years to come

By A. M. Zarem

ELECTRO-OPTICAL SYSTEMS, INC., PASADENA, CALIF.

Nations, being an assemblage of human beings, have an organic history. Like living organisms, they are born, grow, mature, age, wither, and die. This inevitable cycle has produced many parallels in world history. Every schoolboy learns early about the glory that was Greece, and at least some facts about the rise and fall of the Roman Empire.

The birth, rise, and fall of different forms of government took many centuries in history. But things move faster now, and we could be at the tail end of the two or three century era of the American ideal. Have we entered the age of American atrophy?

American industry and the economy of which it is a part is big, strong, and powerful. Like Goliath, it has met and can meet protagonists in open competition and subdue them. Goliath was a lumbering behemoth. He could easily crush whatever was within his convenient grasp. But the Bible tells us that he had neither knowledge nor power beyond that which lay within easy reach of his sword.

countries as well. It has become clear to me that the contest for the minds of the world between the U.S. and Russia is no longer centered in the area of space exploration, as some people still tell us; that Russia has won a firm position in space that we cannot take away from her, no matter how heavy or sophisticated a payload we launch in the future; that Russia has made her propaganda point with Sputnik I that an undeveloped nation starting in 1920 can leapfrog the entire industrial revolution in the short span of four decades and that other undeveloped nations can hope to do the same if they will imitate her. From my observations, educated people in such countries are paying close attention, and are hoping to accomplish a similar development under their own systems.

The U.S. Challenged

Here, then, is a broad area of challenge, and the challenge will become more severe in the future, not only in space but in other technological, cultural, political, and economic areas. Assuming that the world succeeds in avoiding an all-out nuclear war, there will arise other nations to challenge us in all of these fields, and ironically some of them will get there with help from us. Let us pay some attention to the development of our seed corn, to the training of our national leaders of tomorrow. Our system of higher education—collegiate, university, and professional, state-supported as well as privately endowed—must be examined carefully to (CONTINUED ON PAGE 84)

Martin Summerfield's career in rocketry dates back 21 years, and includes participation in the founding of Aerojet Corp. in 1942 and service as chief of JPL's Rocket Research Div. from 1945 to 1949. Now Professor of Jet Propulsion at Princeton, he is also a director of ARS and editor of *ARS Journal*. He was recently elected to membership in the International Academy of Astronautics. Dr. Summerfield notes: "I speak herein simply as a personal observer of educational problems that I have witnessed at a number of American universities. Although I can hardly claim total objectivity or complete information, I have received supporting letters for many of the views expressed here from university presidents, individual professors, businessmen, and others concerned with the state of higher education in the U.S. today."

Goliath was defeated by a vigorous, imaginative young man who realized he could never win by frontal attack in the face of superior conventional arms, and therefore used newer and more modern weaponry that could be conveniently employed at a safe distance with devastating results. The story of David and Goliath, a beautiful parable, is allegorically interpreted as the defeat of brawn by brains. Goliath was actually vanquished by technological obsolescence.

We stand once more at a crest of history whose dimension is the knife-edge of time, engaged in a struggle the outcome of which is not at all certain, although it is sure that success must come to the swift and the smart.

We have yet to learn whether the irresistible force of science and technology will align itself with us or with others. There are fundamental reasons for concern and even doubt as to the outcome, and to draw the picture into focus, one does not have to go back thousands of years to Goliath, or even as much as a hundred years.

Fateful Dates Crowd Us

In fact, we need only go back a little over three years, to the beginning of the Space Age—Oct. 4, 1957—on which day the U.S.S.R. launched the first Sputnik. The anniversary date, October 4, will go down in history as a turning point in (CONTINUED ON PAGE 42)

Abe Zarem, newly elected ARS Director, has served with distinction with the military, the government, and industry during the past 15 years. After receiving his Ph.D. from CalTech in 1944, he joined the Research Dept. of Allis Chalmers, and then en-Tech in 1944, he joined the Research After the war, he became head of the Basic Research Electronics Section of NOTS in Pasadena and from 1948 to 1955 he was with the Stanford Research Institute. He founded Electro-Optical Systems, of which he is president, in 1956.

Ritchey, Pickering head ARS

Elected President and Vice-President, respectively, for 1961, as Ramo, Herrick, Kantrowitz, Cecka, Zarem, and Gerard are named to Board . . . Awards go to von Karman, Stuhlinger, Johnson, Crocco, and Crossfield . . . Annual meeting in Washington draws attendance of 3950

By Irwin Hersey

THE DRAMATIC growth of ARS during the past few years has seldom, if ever, been more clearly demonstrated than at the Society's 15th Annual Meeting, held at the Shoreham Hotel in Washington, D.C., December 5–8. The meeting, which drew a total attendance of 3950, produced the largest technical program in the Society's 30-year history, an imposing Astronautical Exposition which drew record crowds, provocative addresses by luncheon and banquet speakers, and very successful meetings of some 30 ARS standing and technical committees.

Harold W. Ritchey, Technical Director and Vice-President of Thiokol Chemical Corp., was elected President of the Society for the coming year, and William H. Pickering, Director of NASA's Jet Propulsion Laboratory was elected to the post of Vice-President. Robert M. Lawrence continues as Treasurer, Andrew G. Haley as General Counsel, and James J. Harford as Executive Secretary.

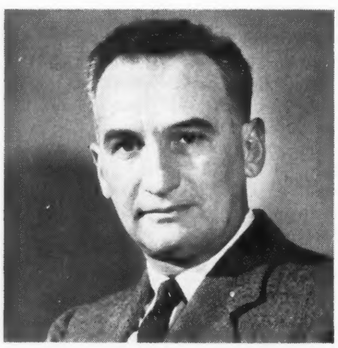
Simon Ramo of Thompson Ramo Wooldridge was re-elected to the Board for a second three-year term, while William J. Cecka Jr. of Rocketdyne, Samuel Herrick of UCLA and Aeronutronic, Arthur Kantrowitz of Avco, and A. M. Zarem of Electro-Optical Systems are new Board members, also serving three-year terms. George Gerard of New York Univ. was named to fill out the unexpired term of Dr. Pickering on the Board, serving for one year.

1300 Applaud Honors

As always, the meeting was climaxed by the annual Honors Night Dinner, this year held in the grand ballroom of the Sheraton-Park Hotel. The event drew an attendance of more than 1300 to witness the presentation of the nation's highest awards for significant achievements in rocketry and astronautics. ARS award winners this year were:

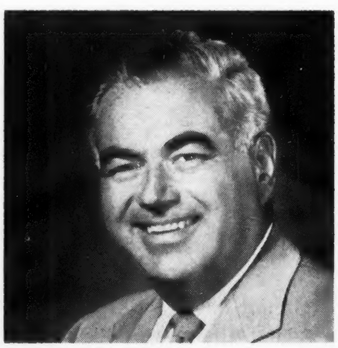
• Theodore von Karman, pioneer in rocket and astronautical research and an inspiration to an entire generation of astronautical scientists and engineers, who won the Robert H. Goddard Memorial Award, the nation's highest honor in the field

NEWLY ELECTED ARS BOARD MEMBERS



Simon Ramo

Samuel Herrick



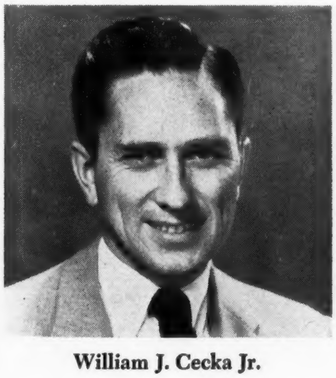
Arthur Kantrowitz

Retiring ARS President Howard S. Seifert (left) turns gavel over to President-Elect Harold W. Ritchey at Honors Night Dinner.

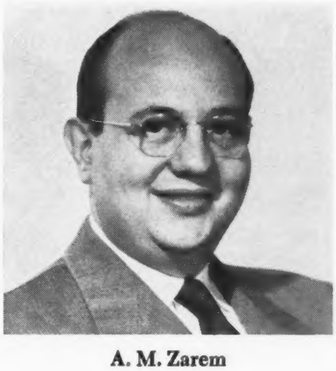
of rocketry and astronautics. The award was accepted *in absentia* for Dr. von Karman, Chairman of the NATO Advisory Group for Aeronautical Research and Development, by Hugh Dryden, Deputy Administrator of NASA.

- Ernst Stuhlinger, supervisory physical scientist at NASA's George C. Marshall Space Flight Center, who received the ARS Propulsion Award for his contributions toward the development of rocket power and in particular for the "establishment of a sound theoretical basis for high-energy propulsion systems."
- Robert L. Johnson, chief engineer, Missile and Space Engineering Dept., Douglas Aircraft Co., awarded the James H. Wyld Memorial Award for outstanding application of rocket power, for his contribution to and leadership in development of the Thor IRBM, also used as a booster for many successful U.S. space operations.
- Luigi Crocco, Aeronautical Engineering Dept., Princeton Univ., who received the G. Edward Pendray Award for outstanding contributions to the literature of rocketry and astronautics.
- Scott Crossfield of North American Aviation, Inc., X-15 pilot-engineer, who won the ARS Astronautics Award for his many contributions toward the development of manned space flight involving great personal risk.
- Julian I. Palmore III, Cornell Univ., who received the $1000 ARS-Chrysler Corp. Undergraduate Student Award for his paper on "A Lunar Impact Probe," describing a design for a moon-probe vehicle which would settle the long-standing controversy as to the composition of the lunar surface.
- Richard J. Hayes, James M. Glassmeyer, and Charles A. Huebner, all Air Force graduate students at MIT, awarded the $1000 ARS-Thiokol Chemical Corp. Graduate Student Award for their paper on "The Duo Plasmatron Ion Rocket."

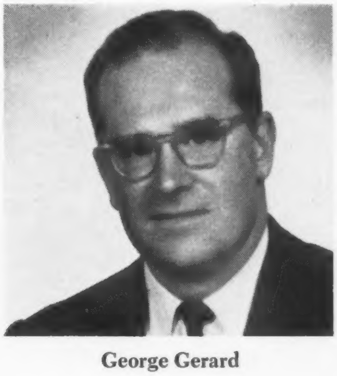
Another highlight of the banquet was the address by Detlev W. Bronk, President of the National Academy of Sciences and of the Rockefeller Institute, who paid tribute to Dr. Goddard and discussed the challenge of astronautics in our world.



William J. Cecka Jr.



A. M. Zarem



George Gerard

ARS President Seifert (right) presents Wyld Award to Robert L. Johnson of Douglas (center) as ARS Meetings Manager Rod Hohl lends a helping hand.

Detlev W. Bronk, Honors Night Dinner speaker, refers to his notes.

Brief talks were also given by outgoing ARS President Howard S. Seifert of United Technology Corp. and Stanford Univ., who discussed ARS activities during the past year, and by Dr. Ritchey, who looked into the future and saw a need for improved communications in the field and closer cooperation with other technical societies.

The meeting kicked off with a mixer on Sunday evening, December 4, which was organized by the ARS National Capital Section and drew an attendance of some 750 people.

The technical portion of the program, marked by 37 sessions and the presentation of more than 150 papers, got underway Monday morning, when five simultaneous sessions were held. The scope of these sessions, devoted to human factors considerations in space vehicle control, biomedical instrumentation for man in space, NASA engine programs,

Policy Statement on ARS Youth Program

Approved by ARS Board, December 8, 1960

The American Rocket Society advocates the support, guidance, and education of youth organizations and other groups interested in the astronautics sciences. The Society, its Sections and its members recognize the necessity of encouraging and assisting programs supplying such support to the full extent of our resources, believing that to do less would be detrimental to the welfare of the nation. Failure to assume leadership in this area would also be an abdication of our responsibility as a major professional society, since such educational activity is one of the foundations upon which a true professional society is built.

Historically, with the rapid growth and national distribution of our membership, the decision was made in 1942 that the Society neither would engage in nor sponsor experimental programs in any phase of the astrosciences, even though our founders initially banded together to implement their pioneering activities in rocket propulsion. Furthermore, the Society is and has always been opposed to all hazardous non-professional experimentation, including (but not limited to) amateur activities using rocket propellants, explosive materials, and uncontrolled projectiles.

At the present time, the American Rocket Society has embarked on a program aimed at alerting the public, and especially our youth, to the importance of astronautics in our daily lives. We recognize that any program encompassing the astronautics sciences must include the study of propulsion. The Society has never abrogated the requirement for emphasis on various scientific fields because of inherent dangers. Therefore, our technical assistance programs include lectures and demonstrations illustrating the theory, design, and proper application of rocket propulsion systems, as well as all other aspects of space flight.

We believe that the scientific contribution made by experimental rocket clubs is negligible in this day of modern astronautics research, and that the educational value of amateur firings exists only in hit-or-miss training of non-professional technicians. Consequently, any testing of rocket powerplants or vehicles which may be desirable in connection with the ARS educational program will not be made by the ARS, and shall be made by fully qualified industrial or military organizations at established launching sites. These organizations will assume full control and responsibility over these rocket experimentations or demonstrations, and the ARS will not sponsor, control, or otherwise participate with respect thereto.

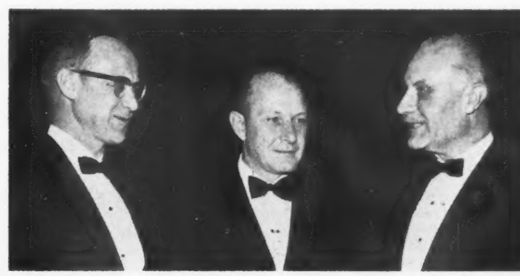
rocket meteorology, and test, operations, and support provides a graphic demonstration of the wide range of interests now embraced by ARS.

Luncheon speaker that day was Brig. Gen. Austin W. Betts, Director of ARPA, who discussed "Ballistic-Missile Defense." In his address, Gen. Betts reviewed the ARPA program in this area, and noted that the most effective type of ballistic-missile defense embraces not only passive techniques, but also an effective counterforce capability and effective civil defense to minimize our losses in the event of an enemy attack. William H. Roennau of the Bureau of Naval Weapons, president of the ARS National Capital Section, delivered the welcoming address, while Dr. Richey was toastmaster.

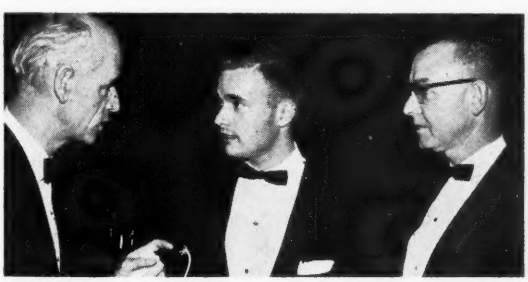
Four technical sessions marked the afternoon program. One, devoted to biological experimentation, featured a panel on human factors and bioastronautics, while another, on solar-terrestrial relationships, was jointly sponsored by the Rocket and Satellite Research Panel, as was the morning session on rocket meteorology. This last session produced one of the meeting's outstanding papers, presenting a new theory on the auroras developed by Syun-Ichi Akasofu of the Geophysical Institute of the Univ. of Alaska and Sydney Chapman of the same institute and the High Altitude Observatory of the Univ. of Colorado (ARS Preprint No. 1444-60).

A special evening session organized by the ARS

From left, G. Edward Pendray, Mrs. Harold W. Ritchey, Mrs. Robert H. Goddard, and Mrs. and Dr. Hugh Dryden of NASA chat at Honors Night reception.



From left, ARS Vice President-Elect William H. Pickering and President-Elect Ritchey chat with Lt. Gen. Donald L. Putt (AF-Ret.), IAS President, at reception.



Award winners get together. From left, Ernst Stuhlinger, winner of the ARS Propulsion Award, makes a point to Julian I. Palmore III, winner of the ARS-Chrysler Corp. Undergraduate Student Award, and Robert L. Johnson of Douglas, Wyld Award winner.

ARS-Thiokol Graduate Student Award winners pose with Wernher von Braun (second from right). From left, Lt. Charles A. Huebner, Capt. James M. Glassmeyer, and Capt. Richard J. Hayes. All worked on award project while graduate students at MIT.

From left, Julian I. Palmore III, ARS Board Member Maurice Zucrow, ARS Director of Publications Irwin Hersey, and ARS Vice-President-Elect William H. Pickering chat at reception.

ARS Board Member Ali Bulent Cambel (left) and Howard S. Seifert chat with Brig. Gen. Austin W. Betts, ARPA Director, a luncheon speaker at the meeting, whose subject was ballistic-missile defense.

ARS officers and committee chairmen greet Dr. Getting prior to his luncheon address. From left, C. J. Wang, Samuel Herrick, Howard Seifert, John Sloop, Martin Goldsmith, Dr. Getting, and David Langmuir.

Special session on public relations and advertising brought together this imposing panel. From left, Murray Snyder of DOD, Joe Stein of NASA, moderator Ed Pendray, John Finney of the *New York Times*, and Earl Spencer of GE.

As always, technical sessions drew impressive audiences.

Registration desks were busy throughout the meeting taking care of the overflow crowd.

Special evening session devoted to communications satellites produced this top-notch panel. From left, Edward Allen of FCC, Harold A. Rosen of Hughes, George Mueller of STL, Sidney Sternberg of RCA, moderator Abe Silverstein of NASA, John R. Pierce of Bell Labs, Brig. Gen. William M. Thames, director of the Army's Advent Management Agency, Leonard Jaffe of NASA, M. J. Weiner of Philco, and Louis Pollack of ITT Labs.

Communications and Instrumentation Committee, headed by Max Lowy of Data Control Systems, brought together a panel of nine outstanding experts on communication satellites to discuss the future implications of such satellites from the commercial and military standpoint. The session, moderated by Abe Silverstein, NASA Director of Space Flight Development, drew an attendance of more than 600 and produced some hot arguments between John R. Pierce of Bell Labs and Harold A. Rosen of Hughes Aircraft Co. as they advanced the merits of the commercial communication satellite systems proposed by their respective companies.

Tuesday morning was marked by four more technical sessions, plus the first ARS Section Management Forum, which brought together ARS Section officers from all over the country to hear papers on various aspects of Section activities. The session was moderated by Rod Stewart of Thiokol, chairman of an ARS Ad Hoc Section Activities Committee appointed earlier in the year.

John Sloop of NASA, ARS Program Committee Chairman, was toastmaster at the Tuesday luncheon, at which Ivan A. Getting, president of Aerospace Corp., was the featured speaker. Dr. Getting, speaking on the company's role in the application of science and technology to military space problems, spelled out in detail the three areas in which Aerospace Corp. will operate—advanced and systems research, general systems engineering, and research.

Tuesday afternoon was marked by the Annual ARS Business Meeting, at which it was learned that the proposal for a $5 dues increase submitted to the membership had been voted down by a 6-to-5 margin; the ARS Section Delegates Conference; and five technical sessions, including a novel "Technical Notes" session chaired by John Sloop and marked by short papers dealing with recent developments and new ideas. The session, designed as a forum for the presentation of such papers, was an outstanding success and is expected to be repeated at future ARS meetings.

Two more technical sessions were held Tuesday night. One was devoted to guidance and navigation while the other, classified Secret, was designed as a panel discussion, moderated by Col. Jack Armstrong of AEC, on the subject of "How and When Nuclear Rockets Should be Flown." The same evening a panel discussion of the role of exhibits in industrial and government communications was held under the sponsorship of the newly formed ARS Exhibitors Advisory Committee.

Wednesday morning saw five more technical sessions, as well as a special session on public relations and advertising and the missile and space program. The session, moderated by ARS Founding Member G. Edward (CONTINUED ON PAGE 60)

Irving Michelson, ARS Education Committee Chairman, listens attentively as luncheon speaker Martin Summerfield makes a point.

Luncheon speaker Abe Zarem (right) obviously thinks comment by Harold W. Ritchey is more humorous than does ARS National Capital Section President William H. Roennau.

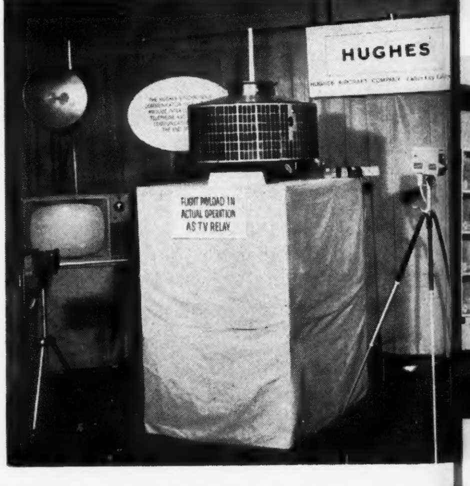
This imposing exhibit was set up for the meeting outside the Shoreham. In left background, a Scout vehicle and, center foreground, a Minuteman missile.

In the Exposition spotlight

89 exhibitors show their wares at the ARS Astronautical Exposition, one of the main attractions of the 15th Annual Meeting in Washington

GE-MSVD booth displayed navigation and control components, nose-cone development work.

Taylor Devices showed new developments in liquid springs and spring shocks.

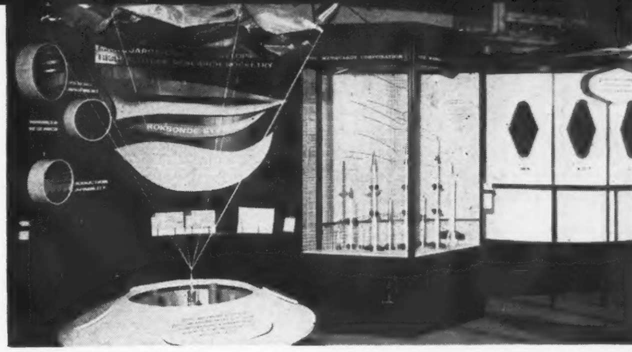


One of the most interesting booths was that of Hughes Aircraft, displaying proposed commercial communications satellite system.

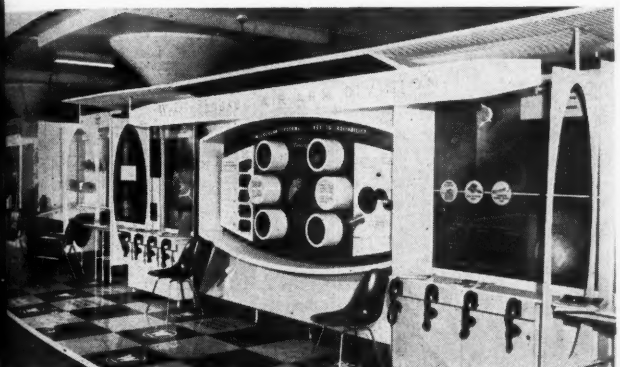
Lockheed Missiles and Space Div. exhibit stressed bioastronautical aspects of space flight.

Lasers, microwave components were spotlighted in TRG exhibit.

Goodrich-High Voltage Astronautics displayed filament- and tape-wound missile components and electric propulsion system developments.

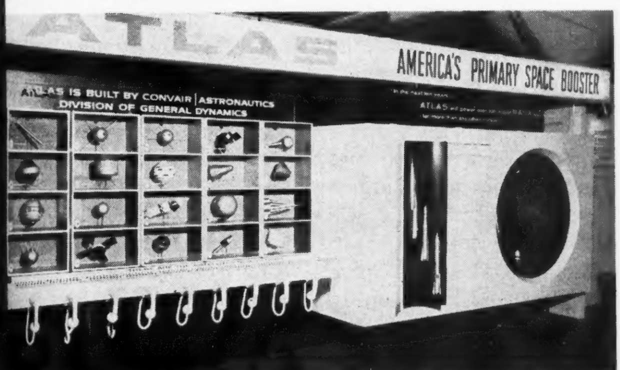


Sounding rockets and payloads were spotlighted in the Marquardt exhibit.



Westinghouse Air Arm Div. displayed recent developments in molecular electronic systems.

Marotta Valve Corp. featured a full line of products on display.



Convair-Astronautics highlighted satellites and space vehicles boosted into space with Atlas.

New molybdenum developments were featured in Climax Molybdenum exhibit.

Full range of Atlantic Research operation was described in its display.

Garrett Corp. booth showed diversification of its activities in space field.

Design Proposal

Solar power in space

Development of thin metalized plastic sheeting with many small holes for use as photoemitter and collector in space could conceivably permit generation of as much as 1 kw of power per 10 or 15 lb of weight

By Thomas Gold

CORNELL UNIVERSITY, ITHACA, N.Y.

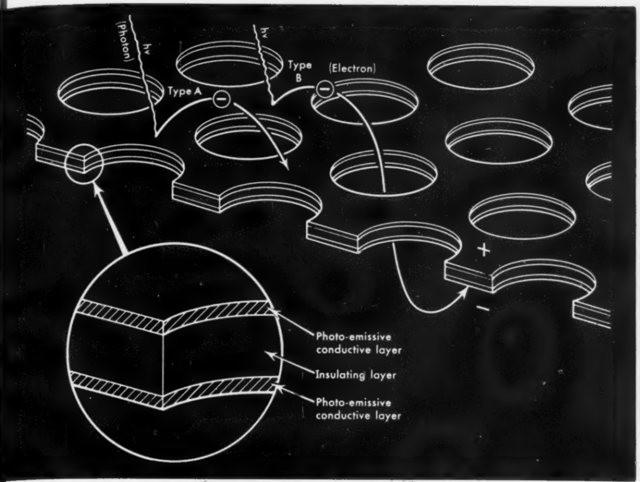
Thomas Gold, now Director of the Cornell Center for Radiophysics and Space Research, has had a distinguished career both in this country and in England. An astronomer and astrophysicist of worldwide reputation, he was from 1952 to 1956 senior principal scientific officer at the Royal Greenwich Observatory and chief assistant to the British Astronomer Royal. He came to this country in 1957 as professor of astronomy at Harvard, and in 1958–59 was Robert Wheeler Willson professor of applied astronomy at that school. He moved to Cornell Univ. in the fall of 1959, where he is professor of astronomy and electrical engineering and chairman of the university's Astronomy Dept. He is at present consultant for a number of companies, among them National Research Corp., Cambridge, Mass. Solar energy studies are being conducted at NRC under sponsorship of Wright Air Development Div.

For much of the space exploration of the future, large power sources will be required to run instrumentation, communications, and perhaps propulsion by means of ion beams. Kilowatts rather than watts of transmitter power would be required to run a full load of instruments from a space vehicle making a close approach to Mars or Venus and capable of communicating back the information that can be acquired. Weight requirements for the power supply will generally greatly exceed weight requirements of the instruments whose operation or whose communication channel is to be supplied.

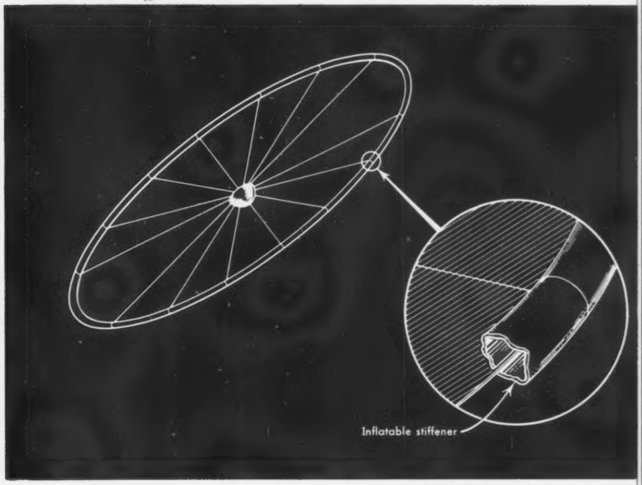
Nearer to Earth, there are functions that a satellite could perform which would be of great value but which require a large supply of available power for long periods of time. For example, an active relay for communication purposes would allow the transmission of signals over a wide frequency band between points that can simultaneously see the satellite, and such wide-band communication systems may eventually become the cheapest means for an enormous expansion in communications traffic over the Earth. Cheap global telephone, teleprinter, and television services may have a profound effect in every sphere of activity.

For such large-scale power requirements in space, nuclear reactors have often been discussed and are regarded as the most promising way of carrying up a large amount of stored energy in comparatively little weight. A variety of solar power sources has also been discussed and it is clear that conventional solar cells cannot readily be adapted to the collection of many kilowatts of power. Such an increase would require extending large rigid surfaces and would make the weight and complexity of the supporting structure grow out of all proportion to the increased power obtained. Solar collectors that focus the solar energy onto a heat engine are another possibility. Large areas of suitably shaped reflectors could be constructed from a light flexible plastic. Probably the hardest part of such a system would be the directional control to point a large mirror correctly at the sun.

If in some way a thin flexible sheet could be given the property of converting some fraction of the incident light into electrical energy, then it would be permissible to have quite low efficiencies for this conversion and still be very well off in an over-all scheme. For solar cells, it is only the need for rigid supports that rule out very



Two types of electron paths can occur. Type A does neither good nor harm. Type B, on the other hand, implies a current from front to back which delivers power. Inset shows design of plastic sheeting.



Large area of sheeting might be held out by a stiffener used around the rim, in this manner.

large areas. If a thin flexible sheet could be used instead, then enormously larger areas could be contemplated than those afforded by paddle wheels or any other unfolding solid structures.

It may be possible one day to devise a material that can be made in the form of a thin flexible sheet which has the solid-state properties of the kind utilized in present solar cells. But no material of this kind has yet been discovered. It is therefore necessary to look for other effects which might be adaptable for use in thin sheets.

Sunlight falling on suitably prepared surfaces will cause the emission of electrons with energies that are comparable to the photon energies of the incident light—that is to say, generally in the region of a few volts. Is it possible to make a device that utilizes the energy resident in these electrons?

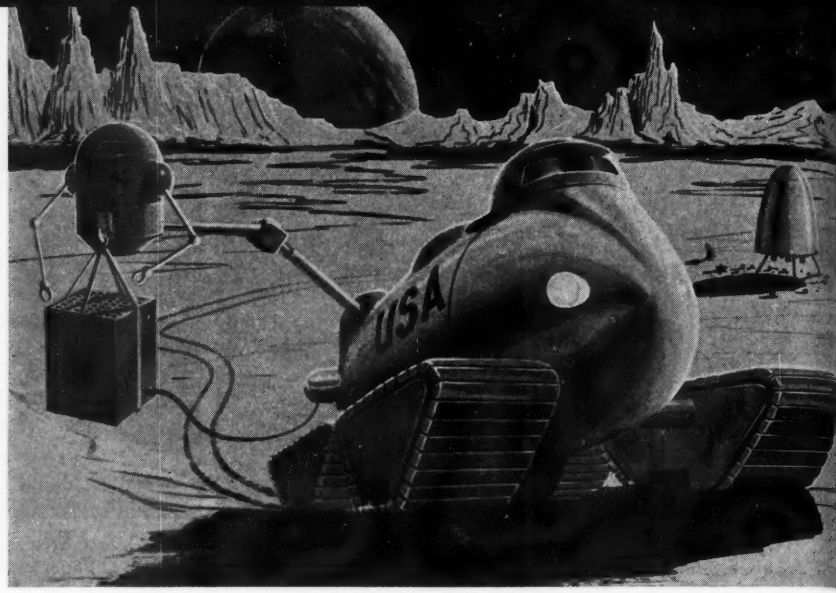
Charging of the Collector

If a collecting surface were placed in the vicinity of the emitting one, so that some electrons would run into this collector, then it would be possible to allow the collector to charge itself negatively without yet holding off all further incoming electrons. The negative potential to which the collector could be allowed to go would be just comparable with the electron energies, which in turn were given by the photon energies, and which were a few volts. A current composed of electrons would therefore continue to flow from the emitter to a more negative collector, and power would thus be available in letting this current return through a load. It would be the solar light energy that had pushed the electrons against an electric field and that therefore put energy into electrical form.

It is very difficult for various reasons to construct a collector that will collect a significant proportion of the electrons that have been driven out of the surface. First, it would have to be so constructed as not to shade the emitting surface. Nevertheless, a large proportion of electrons coming off the surface in random directions would have to be intercepted by this collector. Second, the distance to which electrons would jump off the surface before falling back to it under electrostatic forces is only very small. In practical cases, it might be a few thousandths of an inch. A collector, to be at all efficient, would therefore have to be spaced so close to the surface as to catch these electrons before they return, and it is difficult to see how that could be done except with a high-accuracy rigid structure, and therefore with a system which is again unsuitable for very large areas in our space application. There is, however, another possibility which circumvents the difficulty.

For best operation, it would seem necessary that the collector should be in front of the emitter, but it is not at all clear that this must be so if one is prepared to tolerate a slight loss in efficiency. If we took a thin sheet and gave it very many small holes and then inquired into the fate of electrons emitted from one surface, we would find that a certain proportion had found their way accidentally through the holes and had been picked up on the back surface. If the holes formed quite a large fraction of the exposed area, then many electrons falling back toward the sheet would in fact miss it and fall through a hole instead. Another way of saying this is that the space charge of electrons that will be established in the steady configuration, when electrons are being boiled off and re-absorbed, is distributed to both sides of the sheet.

This suggests, therefore, that the collector can be on the back. Instead of (CONTINUED ON PAGE 68)

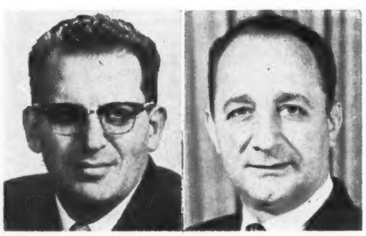


Lunar surface vehicles

Forward-looking, ingenious engineering will be necessary to provide astronauts with vehicles of broad capability for lunar exploration

By Lawrence L. Hofstein and Angelo W. Cacciola

GREENWICH ENGINEERING DIV., AMERICAN MACHINE AND FOUNDRY CO., GREENWICH, CONN.



Lawrence L. Hofstein is a senior mechanical engineer of the AMF Greenwich Engineering Div. He has been directly engaged in rocket, missile, GSE, and aerospace activities since 1946, as project engineer at the M. W. Kellogg Co. and at East Coast Aeronautics, Inc., and for the past six years with AMF, where he was manager of the Talos System Section. While on leave of absence from Kellogg, he served as consultant to the British Ministry of Supply on solid propellants. He is a licensed professional engineer of New York State.

Angelo W. Cacciola has been engaged in machine design and engineering in various fields since receiving a degree in mechanical engineering from the Polytechnic Institute of Brooklyn in 1943, for the past eight years with AMF, and for the last two years on GSE for space programs. His experience includes aircraft propeller design, automatic aircraft refueling mechanism design, and rocket engine component development. He is a licensed professional engineer of New York State.

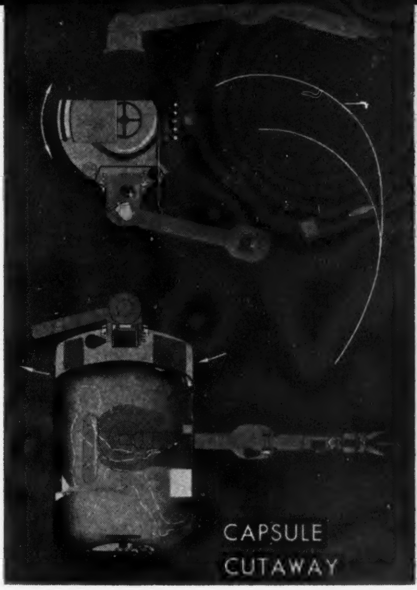
TODAY we accept satellites whirling overhead as a matter of course—the very satellites which but a few years ago were subjects of papers presented at poorly attended sessions of the ARS. Similarly, in the 70's, we will view manned landings at a lunar base, with a tinge of excitement, perhaps, but with equal aplomb. Establishment of a moon base will be preceded by many unmanned shots, initially hard, then soft, until sufficient reliability is achieved to land a man on the lunar surface.

As our activity increases beyond simple probing, we will need vehicles of broad capability to take men on explorations of the lunar surface. These vehicles, involving many problems and requiring extensive development in bringing them into being, must be available at the same time as the powerplant and flight system which will accomplish the prime mission, lunar landing.

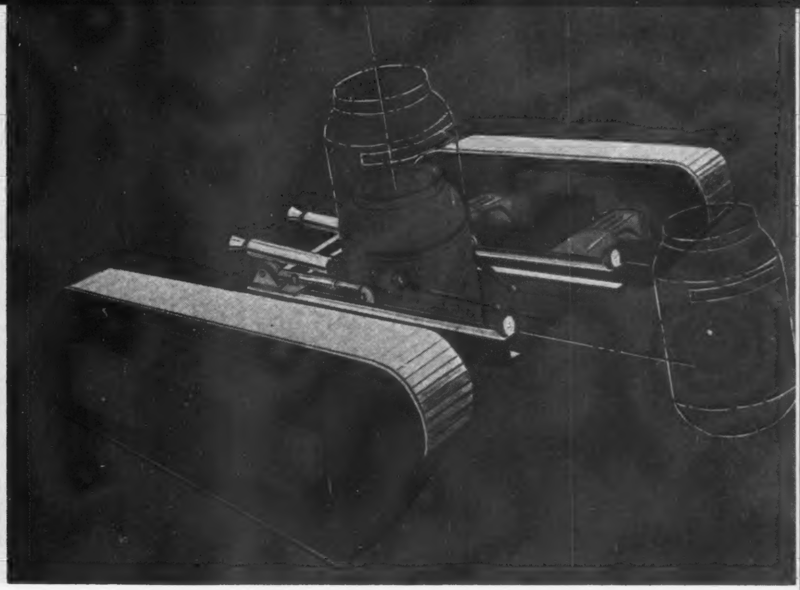
What should such vehicles be like? Before considering this question, two areas must be explored: Lunar environment and functions of a vehicle on the lunar surface.

As is widely known, the environment a vehicle would encounter on the Moon, with $^1/_6$th the Earth's gravity, would differ considerably from that of the Earth. For surfaces facing the sun, the temperatures average about 212 F in the hottest areas, with a maximum of 272 F. Temperatures drop to —243 F or less during lunar night. Both day and night last approximately two weeks. There is practically no atmosphere, 10^{-12} atm being estimated as a maximum pressure. Wind and weather cannot exist in this vacuum, and there is no free water. In the absence of attenuation, intense solar and cosmic radiation can be expected.

Visual studies of the Moon have shown three main types of surfaces: Maria and lava-flooded craters, all rather flat, and sometimes fissured; regions composed of vast masses of ejected

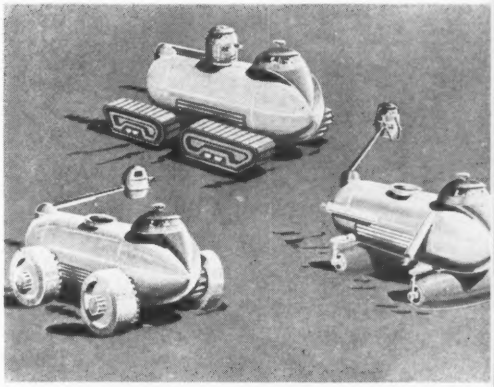


One-Man Capsule



One-Man Vehicle

or displaced material; and areas of the original crust, comparatively smooth and peppered with small craters. The smallest feature identifiable visually measures 0.1 mi. Recent work using radar has suggested the existence of layers of dust in the maria. These may be coated with a skin of compacted material of varying thickness. Any means of locomotion postulated for the Moon, therefore, must be capable of traversing surfaces varying among smooth level and steep inclines, fissured rough terrain, and possibly layers of dust-like material—all under conditions of wide temperature change and almost complete vacuum.

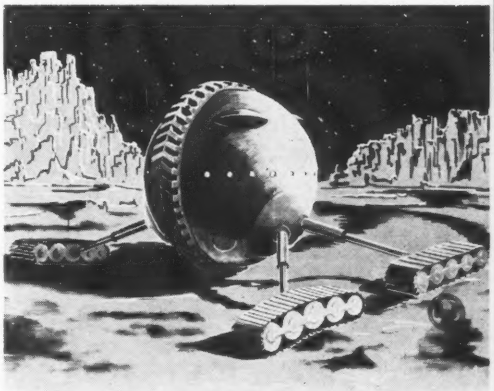


Types of Locomotion

Functional Requirements

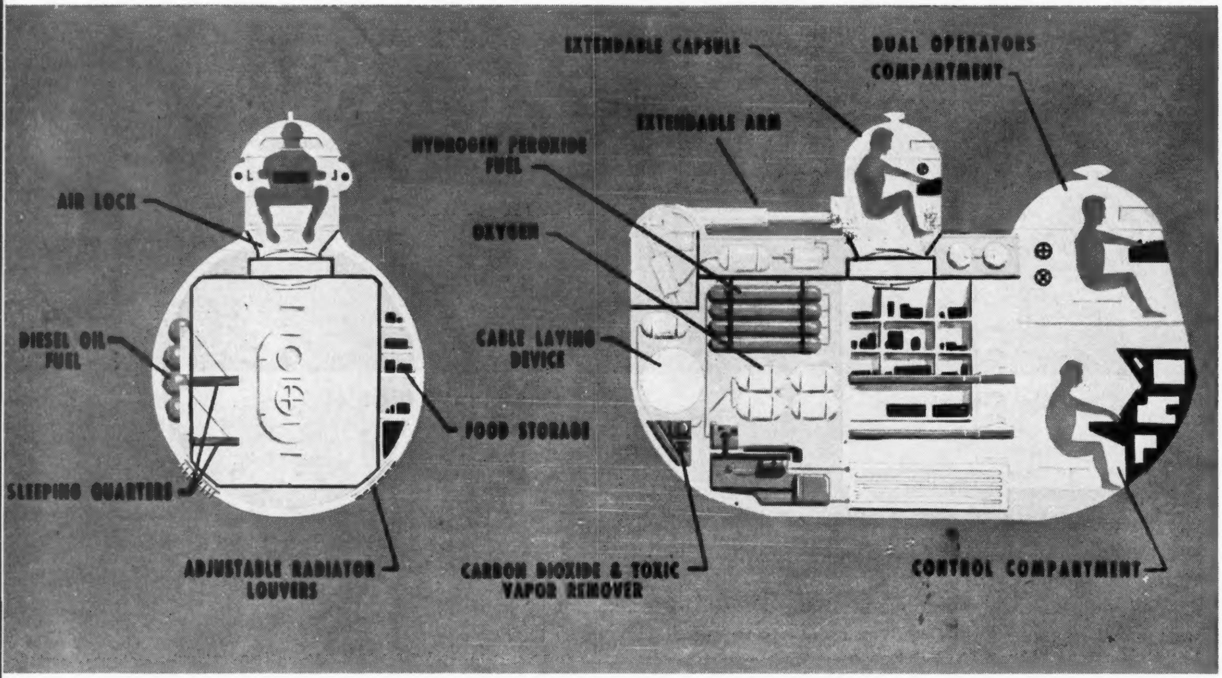
Assuming this environment, we can now set forth some functional requirements for lunar vehicles. Once on the Moon, we will want to learn as much about the environment as possible. Robots, both surface and hovering, as part of the initial, soft-lunar-landing systems can help us to do this by being equipped to carry out the following functions: Surface exploration, evaluation of environment, atmosphere sampling, chemical and physical surface analysis, seismic experiments, gravitometric measurements, and determination of magnetic field. These robots need only have sufficient power to move from the immediate vicinity of the soft landing, perform the requisite tasks, and relay acquired information back to Earth.

The next stage in development might be one-man surface vehicles with similar capability. For an initial manned exploration of the lunar surface, we might think about a total, round-trip distance on the lunar surface of 5 mi to be covered in 2 hr. This mission would be about the same as that for the robot vehicle, but with manned observation added.



Three-Man Spherical Vehicle

Finally, as manned operations on the Moon expanded, broader functions would be required, such as the following: Exploration; construction of lunar base; personnel transfer; remote emplacement of instrumentation; equipment servicing, repair, and



Three-Man Cylindrical Vehicle

maintenance; remote emplacement of powerplant; and connection of remote equipment to lunar base. For these functions, it is conceivable that a vehicle capable of making a round trip of 50 mi and sustaining three men for 72 hr would be satisfactory.

Three-Man Lunar Vehicle—Weight Summary (lb)

Propellants	5000
Structure	2000
Engine, drives, and battery	970
Life support, including containers	1850
Electrical and electronic equipment	630
Fixed equipment, including heat exchanger	1210
Tools and miscellaneous	870
Locomotion means	1300
Capsule	350
Capsule boom, drives, and controls	820
Total	15,000

With the introduction of man into a lunar-exploration system, the question of how he can best perform the functions required of him arises. Should he don a spacesuit and venture from the vehicle or base, or is some other operation more practical? Our opinion is that housing the man in a manipulator-equipped capsule attached to a vehicle is preferable to a spacesuit.

Astronauts' Needs

To function in a hostile environment over an extended period, a man must be furnished with food and oxygen and his waste products must be removed or stored. The pressure and moisture content of his environment must be controlled. In a lunar environment, sufficient thickness of material must be present to protect him from cosmic rays, ultraviolet rays, and other radiation and from micrometeorites, atmospheric leakage, static charges and, in general, from the antipathetic lunar environment. The man must be provided with means for observation and perception, as well as locomotion, without too seriously (CONTINUED ON PAGE 52)

Proton radiation hazards in space

An adequate picture of proton radiation hazards, and inference about shielding, requires proper definition of basically different Van Allen Belt, solar-flare, and human depth-dose patterns

By Hermann J. Schaefer

U.S. SCHOOL OF AVIATION MEDICINE, PENSACOLA, FLA.

As THE volume of information grows on radiation intensities in space, it becomes abundantly clear that high-intensity radiation fields are by no means limited to the zones of the Van Allen Belt, but must be considered a universal phenomenon of interplanetary space, distinguished from the Van Allen Belt only by being transitory. The single major cause of these additional radiation fluxes is solar activity, more specifically, solar flares.

Long before the satellite era, cosmic-ray physicists produced indirect yet strong evidence that the extra-atmospheric "cosmic-ray" intensity during and after large solar flares increases by several orders of magnitude. In the meantime, direct observations of flare-produced proton fluxes with balloons and space vehicles have confirmed the early conclusions and furnished strong evidence that different flares emit different types of proton beams.

One kind comprises a wide energy range up to 1 bev and beyond. This is the rarer type, which makes itself felt down to sea level. The other, much more frequent one is limited to an energy range not greatly exceeding 100 mev and, therefore, does not penetrate very deeply into the Earth's atmosphere. During 1959, this second type of event has occurred with an average frequency of at least one per month.

Although these transitory radiation fluxes contain a variety of particles—such as protons, electrons, neutrons, and photons—the main importance for radiation effects on man and for the shielding problem rests with the proton component.

When the implications of radiation measurements in extra-atmospheric regions for the exposure hazard are discussed, it should be realized that a schematic conversion of telemetered ionization densities and particle numbers to rep (roentgens equivalent physical) or rep/hr values cannot furnish a true picture of the radiation burden in a human target. The cosmic-ray apparatus of the physicist usually is not designed for a tissue-equivalent measurement of radiation dosages. The latter purpose would require the determination of three magnitudes—the tissue equivalent ionization dosage in rep, the LET (linear energy transfer) of all components involved, and the depth-dose pattern in a (CONTINUED ON PAGE 62)

Hermann J. Schaefer is head of the Biophysics Dept. of the U.S. Naval School of Aviation Medicine. He received a Ph.D. in physics and biophysics from Johann Wolfgang Goethe Univ. in Frankfurt am Main, Germany, in 1929, and before coming to this country in 1948, was professor of biophysics at that university. Dr. Schaefer is engaged in research on the biological significance of background ionization and radiation in space.

Space Flight Report to the Nation Interim Report

SFRN Committee formed by von Braun

37 leaders of space-flight community to map broad objectives of meeting, advise working committees . . . Exposition space going fast

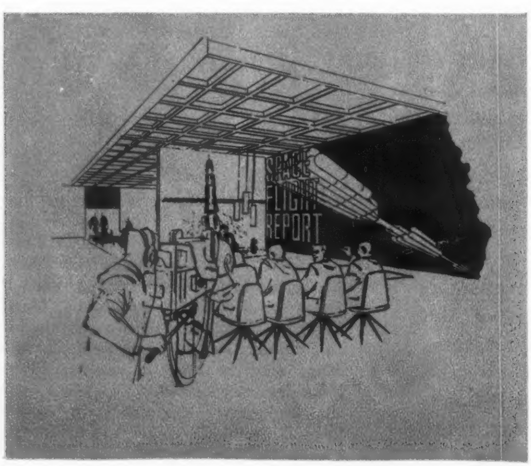
By Rod Hohl

ARS MEETINGS MANAGER

Although the meeting is still a full nine months away, preparations for the ARS SPACE FLIGHT REPORT TO THE NATION got into full swing with announcement of the makeup of the Space Flight Report to the Nation Committee by its chairman, Wernher von Braun.

The Committee, which will map the broad objectives of the meeting and advise the working committees, will be comprised of 37 leaders of the space flight community. Members of the Committee are:

Harold R. Boyer	General Motors Corp.
Detlev W. Bronk	National Academy of Sciences and Rockefeller Institute
Overton Brooks	House Committee on Science and Astronautics
Milton U. Clauser	Clauser Technology Corp.
James R. Dempsey	Convair-Astronautics
James H. Doolittle	Space Technology Laboratories
C. Stark Draper	Massachusetts Institute of Technology
Hugh L. Dryden	National Aeronautics and Space Administration
Trevor Gardner	Hycon Manufacturing Co.
Mrs. Robert H. Goddard	Worcester, Mass.
Harry F. Guggenheim	New York, N.Y.
Willis M. Hawkins	Lockheed Aircraft Corp.
John T. Hayward	Vice Admiral, U.S. Navy
Samuel K. Hoffman	Rocketdyne
Robert H. Jewett	Boeing Airplane Co.
Arthur Kantrowitz	Avco-Everett Research Laboratory
Dan A. Kimball	Aerojet-General Corp.
John B. Medaris	The Lionel Corp.
George F. Metcalf	General Electric Co.
Don R. Ostrander	Major General, U.S. Air Force NASA Launch Vehicle Programs
William H. Pickering	Jet Propulsion Laboratory
Richard W. Porter	General Electric Co.
Simon Ramo	Thompson Ramo Wooldridge
Harold W. Ritchey	Thiokol Chemical Corp.
Bernard A. Schriever	Lieutenant General, U.S. Air Force, Air Research and Development Command
Howard S. Seifert	Stanford University
Abe Silverstein	National Aeronautics and Space Administration
John P. Stapp	Colonel, U.S. Air Force Aerospace Medical Center
George P. Sutton	Rocketdyne
Holger N. Toftoy	Major General, U.S. Army (Ret.)
George S. Trimble Jr.	The Martin Co.
Arthur G. Trudeau	Lieutenant General, U.S. Army Office of Research and Development
Harold C. Urey	University of California
Theodore von Karman	AGARD, North Atlantic Treaty Organization
Alan T. Waterman	National Science Foundation
Elmer P. Wheaton	Douglas Aircraft Co.
Herbert F. York	Defense Research and Engineering



George Gerard, the 1961 ARS Program Committee chairman, charged with responsibility for the meeting program, announced that abstracts are now being accepted. These abstracts should be mailed directly to the ARS Technical Committee Chairman with cognizance over the field in which the paper falls or to ARS headquarters in New York. The deadline for all abstracts is *April 15.*

In addition to the usual technical sessions, Dr. Gerard said that it is also planned to hold three interdisciplinary sessions. These sessions will be planned around a theme stressing the interplay of disciplines in a project.

On the Exposition side of the meeting, reservations for space have now exceeded the halfway

mark. The entire second floor is sold out, and substantial areas on the first and third floors have also been blocked off.

The response both to the technical program and the Exposition have resulted in an early demand for available hotel space. Since hotel rooms are particularly scarce in New York in early October, ARS has reserved a block of 3500 rooms for attendees of the SPACE FLIGHT REPORT TO THE NATION. Room reservations can be made through the New York Convention Bureau on the form provided below.

Application For Hotel Accommodations

Please fill out this application form completely and mail it to:

Miss Sylvia Peltonen, Secretary
ARS Convention Housing Committee
90 East 42 Street
New York 17, N. Y.

HOTEL	SINGLE	DOUBLE	TWIN BEDS
ABBEY, 151 West 51st St.	8.00- 9.00	10.50-12.50	12.50-14.50
*BARBIZON-PLAZA, 106 Central Pk. So.	13.50-15.50		17.50-21.50
*BARCLAY, 111 East 48th St.	15.50-21.50		23.50-27.50
*BELMONT PLAZA, Lexington Ave. & 49th St.	8.50-16.00	14.00-19.00	16.00-20.00
*BILTMORE, Madison Ave. & 43rd St.	8.00-20.00	15.00-25.00	15.00-25.00
*COMMODORE, Lexington Ave. & 42nd St.	8.50-16.50	14.00-20.50	15.00-23.00
*DIXIE, 250 W. 43rd St.	9.00-12.00	12.00-15.00	13.00-17.00
*EDISON, 228 W. 47th St.	8.00-11.00	15.00-18.00	15.00-21.00
*ESSEX HOUSE, 160 Central Park So.		22.00	22.00
*GOVERNOR CLINTON, 7th Ave. & 31st St.	10.00-14.00	14.00-26.00	14.00-20.00
*HENRY HUDSON, 353 W. 57th St.	8.00-11.00	12.00-16.00	13.00-18.50
*MANGER VANDERBILT, Park Ave. & 34th St.	8.50-21.00	13.00-21.00	15.50-21.00
*MANHATTAN, 8th Ave. & 44th St.	9.00-14.00	14.00-18.00	15.00-18.50
*MAYFLOWER, Central Pk. W. & 61st St.	12.00-16.00		14.00-17.50
NEW YORKER, 8th Ave. & 34th St.	8.00-14.50	11.50-18.00	15.50-20.00

HOTEL	SINGLE	DOUBLE	TWIN BEDS
PARAMOUNT 235 West 46th St.	8.00- 9.00	10.00-12.00	12.00-14.00
PARK LANE, 299 Park Ave.	19.00	24.00	24.00
*PARK-SHERATON, 7th Ave. & 55th St.	11.00-16.00		15.00-20.00
*PIERRE, 2 East 61st St.			24.00-30.00
*PLAZA, 5th Ave. & 59th St.			23.00-30.00
*ROOSEVELT, Madison Ave. & 45th St.	8.50-20.00	13.50-24.00	17.50-25.00
*ST. MORITZ, 50 Central Park So.	13.00-16.00		16.00-20.00
*SAVOY HILTON, 5th Ave. & 58th St.	19.00		23.00
*SHERATON-ATLANTIC, Broadway & 34th St.	9.00-14.00	13.00-17.00	14.00-18.00
TAFT, 7th Ave. & 50th St.	10.75		17.50
VICTORIA, 7th Ave. & 51st St.	9.00- 9.50	12.50-13.00	14.50-16.00
*WALDORF-ASTORIA, 301 Park Ave.	12.00-28.00	18.00-28.00	18.00-28.00
*WARWICK, 65 West 54th St.	18.00		22.00
*WELLINGTON, 7th Ave. & 55th St.	8.50-12.50	13.00-18.00	13.00-18.00
WOODSTOCK, 127 W. 43rd St.	7.00- 9.00	10.00-14.00	10.00-14.00

Rates subject to 5% New York City tax on hotel rooms. *Suites available. For reservations contact housing bureau.

———————————— CUT ALONG THIS LINE ————————————

Hotel Accommodations Desired. (It is necessary that five choices of hotels be listed below:)

CHOICE	HOTEL	TYPE OF ROOM DESIRED: SINGLE 1 PERSON	ONE DOUBLE BED— 2 PERSONS	TWIN BEDS 2 PERSONS	INDICATE APPROXIMATE RATE AS SHOWN IN SCHEDULE
1st					
2nd					
3rd					
4th					
5th					

If accommodations are not available at any of the above hotels, reservations will be made at some other suitable hotel.

NAME..

ADDRESS..

CITY.. STATE..

DATE ARRIVING.................... ARRIVAL HOUR.................... DATE DEPARTING....................

Please list names, affiliations and desired accommodations for additional persons on separate sheet and attach to this form.

NOTE: There will be an interval of several weeks before you can expect to receive a direct confirmation from the hotel accepting your reservation. Room numbers cannot be assigned by hotels until guests register on arrival.

New Nose for X-15

Neil Armstrong, an NASA pilot for the X-15 rocket-powered aircraft, inspects its new Q-Ball nose cone, developed by Northrop Corp.'s Nortronics Div. The ball contains a hydraulically actuated sphere with many sensing ports and servomechanisms to point it directly into the relative wind. Offsets go to the pilot, who can then trim the aircraft. Liquid nitrogen cools its internals, and a boron-nitride seal keeps air from passing between sphere and cone.

Generals, Government, Goliath

(CONTINUED FROM PAGE 25)

world affairs. Its shocking message, it is hoped, may have erased the smug and complacent notion that American technology is alone or supreme. It should also have brought awareness of the increasingly important role that science and technology will play in the world of tomorrow.

Science is simply a body of knowledge. It does not come labeled: To be used for good or bad. It is spawned by man's creative curiosity about nature, not by government contract or by the motive or desire for profits. The things of science, however—the practical extension of scientific principles to the making of devices useful or destructive, be they radios, automobiles, A-bombs, or garbage disposals—all fall into the category of industrial technology. The explosive nature of the development of technology has only been matched in vigor by its explosive impact on society and our way of life, and the pace still quickens. Of all the scientists and engineers who inhabited this Earth since the beginning of time, over 90 per cent are still alive! Imagine the strides yet to be made.

Who can predict what our state of affairs will be in the year 2000? Which of us has courage enough to say what we will and won't be able to do? It appears certain that in the lifetime of the present generation, man will have made excursions into space and returned; will have landed on the moon and returned; will probably have landed on Venus and Mars—and heaven alone can say what other wonderful things will have been accomplished.

But making such things happen will not be simple, routine, or automatic. Many things will have to change, most importantly, many of our preconceived attitudes, particularly those related to our impatience with obtaining knowledge for knowledge's sake. These changes in attitude must occur principally in recognition of the importance of science, research and development activities, and technology. We must look forward to and expect a more complete understanding of the effective management of these activities and their influence and support.

There are concrete evidences of this trend before us every day. We live in an era of change, and nowhere in the world is this change being more rapidly paced than by the totality of activities of the various government agencies, both civilian and military, which sponsor research. The strength of these agencies has grown enormously since World War II.

The world does not stand still. It has been well noted that in the interval from 1940 to 1945 this nation, previously possessing almost no military machine, built the mightiest, most destructive military force in the history of mankind. The world has recognized, and we should too, that this feat evolved by tapping the enormous reservoirs of capability which we had built up in the scientific, industrial, and management areas during times of peace.

If nothing else, this Herculean task illustrated a simple truth: There is a direct relationship between intellectual activities and the establishment of a scientific body of knowledge and the development of technological strength, industrial strength, economic, military, and political power. In the words of Carlyle, "There is no knowledge that is not also power."

Perhaps the most dramatic event in our lives today is the more or less complete disappearance of physical, earthbound, and ordinary frontiers. It becomes abundantly clear that the frontiers we face are now those of space, and are largely intellectual in nature.

In our scientific curiosity about space may lie our only hope for survival. Scientific achievements in space have become directly related to technological power. The world watches and waits to see which country has the superior scientific capability of harnessing the forces of nature by exhibiting the greatest success in the conquest of space.

Since we are a peaceful people, untold numbers of lives will be saved throughout the world if we can perform in this area so as to outshine all competitors. We shall not do so without vast and significant advances in science and technology beyond what we are achieving in this country today. The reason is clear. The job is complex. The Manhattan District program was a relatively easy task compared to the total problem of an effective conquest of space. But it has to be done.

It is simple. The desire to conquer space accelerates our activity in science and technology, and science and technology are important to everything. The conclusion is inescapable: The conquest of space must become a national symbol.

The Space Principle

Perhaps the strongest appreciation of the principle is found in those whose business it is to insure our military strength, and a few diehards in NASA and now in AEC. These people, categorized here as "the generals," have as a group come a long way from the attitude: "Git thar fustest with the mostest." The battle cry now is: "Get there first with the best." They understand that the concept of a super or ultimate weapon is a dangerous trap.

The ultimate weapon is that decisive weapon of superior firepower you possess and the enemy does not. Understanding this, the generals realize that while they must have present-day state-of-the-art hardware and equipment on hand with which to fight, if need be on a moment's notice, a portion of the financial substance at their command must go into making sure that that equipment operates as reliably as possible under severe conditions. Furthermore, large support must be directed toward those activities of an R&D nature which will lead to new breakthroughs and new applications, techniques, devices, components, and systems of advanced performance for use in later years.

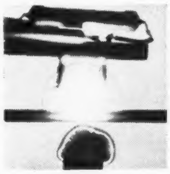
Advances in modern weaponry have called forth from our laboratories an endless stream of developments in many fields that have given the military man an intimate contact with forward technology probably not enjoyed

Kodak reports on:

strange dances in the movies . . . a definition of "very good" . . . polyester electrically upgraded

Favor for the high-speed congress

Dust Performs for Plant's Pollution-Control Movies, *Chem. Week*, 84:84, 86, May 2, 1959. (Procter &Gamble uses high-speed motion-picture sequences for the qualitative control of in-plant dust.)



The Ignition of Explosives by Radiation, J. Eggert, *J. Phys. Chem.*, 63:11-15, Jan., 1959. (High-speed photography proves that the detonation of nitrogen iodide starts before the light flash ends, showing that only a fraction of the energy is used for the detonation.)

Lathe Check Formation in Douglas-fir Veneer, E. H. Collins, *Forest Products J.*, 10: 139-40, March, 1960. (High-speed motion pictures were used by Weyerhaeuser Company to analyze production variables.)

Time after time we have visited a customer proud of some accomplishment with high-speed movies. He is willing to show us—eager, delighted to show us. The projector is started and we watch. We see a collection of strange objects. We don't know for sure what they are. Little seems to be happening. After quite a while, a new object enters the scene from the left. Shortly another new object comes up from the bottom. The two dance around each other, touch, and exit from the top of the frame. All is again static on the screen. After another while the reel comes to its end and we jump to our feet exclaiming hearty congratulations.

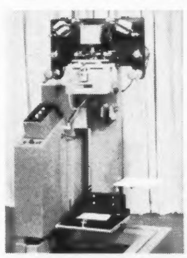
He deserves congratulations, probably. If we had lived with the problem as he has, the objects in the picture might have seemed no stranger than the face in the bathroom mirror; the dance might have been the triumphant, forceful, sudden, undisputed clincher to a vexatious problem; the enthusiasm of the born salesman might have meant more.

Nevertheless, we need not be ashamed. We help scientists and engineers use high-speed photography by manufacturing a group of films to the stringent mechanical requirements of high-speed cameras. *Kodak Plus-X Reversal Film* we make for reversal processing to a fine-grain positive. *Kodak Tri-X Reversal Film* is four times as fast. *Kodak Double-X Panchromatic Negative Film*, which is a bit faster yet and very sharp, is picked when a quick negative will suffice or when several prints may be wanted later. *Kodak Royal-X Pan Recording Film* is picked only when light is very limited indeed; *Kodak Linagraph Ortho Film*, for accentuated sensitivity to green light; *Kodak High Speed Infrared Film*, for sensitivity to 9000A, with a maximum from 7700A to 8400A; *Kodachrome Film*, for color, with low-cost commercial processing widely available; *Ektachrome ER Film*, for color at exposure index of 160 or higher.

Another thing. A bibliography on high-speed photography. Every item our library knows. Forty-six pages of items like the specimens at the immediate left. No pictures, though. No charge either. Coverage extends into 1960. Got it ready to distribute to the Fifth International Congress on High-Speed Photography in Washington in October.

Eastman Kodak Company, Photorecording Methods Division, Rochester 4, N. Y., would be glad to send the bibliography or answer questions about the above-named films.

High-fi photography for highbrows



This enlarger was custom-built. The client's affairs are of such a nature that to supply him with anything short of the best-performing merchandise that money can buy could have disastrous consequences for all men of good will. The enlarger is a link in an astonishing chain on which much depends.

It is indeed a very good enlarger. We are tempted to resort to the cant of the times and call it a breakthrough in enlargers. We shall resist the temptation because we hate to lie. Nothing as climactic as a "breakthrough" has occurred in enlargers.

The reason it's a very good enlarger (the best in the world, we hope) is that some years ago it became apparent that descriptions like "very good" don't help much in dealing with such problems and that more precise-sounding terms like resolving power don't tell a full and honest story either. Progress came when we adopted the *weltanschauung* of the sound engineer, of all people!

Can you imagine the audacity of treating a photographic lens or a photographic emulsion or a combination of the two as though it were a loudspeaker or a telephone line and developing equations for its sine-wave frequency response? Yet this is what we were forced to do and it worked. The enlarger at the immediate left can prove that it worked. The photographic-emulsion men and the lens men are given a common language, which they had lacked. The frequency response of a combination as in this enlarger can be cascaded with the frequency response of other elements in the total picture-handling system, including the electronic, if any.

We have good reason to want to convince you that this nonsense is not as foolish as it sounds. We think that in the long run we shall be better off if we let you in on the principles by which we design a photographic *system* even though, under certain circumstances, we wish you would let us (George's successors) do it for you.

Education had best begin by studying a review paper, "Methods of Appraising Photographic Systems," by one of our men who has been up to his ears in this subject for a couple of decades. Get your free copy from Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y. Freshman calculus and doggedness required.

New recipe

We have a new polyester resin recipe. It results in a dielectric constant that is really constant up to 130° C, which could not be said of earlier polyester. Its dissipation factor is 0.3% at 100°C, where the old ran to 1.2%. Since it also better resists humidity, acid, and bases, it is excellent for insulation. As a capacitor film at 2000 v/mil, it outlasts the old 8 to 1.

Eastman Chemical Products, Inc., our subsidiary, sells the resin. Acme Backing Corporation, Canal and Ludlow Streets, Stamford, Conn., turns it to what others call film and we (for whom "film" has another meaning) call sheeting. Acme will gladly expatiate.

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

Kodak
TRADEMARK

by any other single group in this country, including especially our industrialists. Radar of all types, advanced fire-control systems, modern navigation aids, communication, telemetry, homing, guidance, and other systems are in his daily diet. The computer, to him, is not a bookkeeping machine, but the heart of many control systems whose functions he must appreciate. These technological demands call for men with more and more appreciation of science and more and more technical training.

It is for this reason that greater stress is constantly being placed on providing proper technical training for military personnel. Over 50 per cent of all U.S. military officers today have earned college degrees. If this trend continues, it would be no surprise to find military scientific needs spawning the technological advances from which we may develop a stronger competitive position in world trade, a sounder commercial economy, and, in fact, a higher standard of living.

But there are counteracting trends. All is not sweetness and light. Much of the military is extraordinarily conservative. New ideas are not acceptable in many places, because they are untried and their success is in doubt, and, in other places, because they obsolete the pet programs of some groups. The penalties for making a mistake are such that it is safer to say "no" and never find out how wrong you were, than to say "yes" and get caught being even slightly wrong. Such an atmosphere stifles initiative and progress. It can be changed. We must make the rewards for being right much greater than the penalty for being wrong.

In spite of these drawbacks, we will succeed in our space ventures because of the genuine need by the military for the best and most reliable equipment.

But this will not happen suddenly. The need for new ideas, technology, and equipment is appreciated by all, but the actual steps to effect procurement involve processes and actions of that nebulous combination of bureaus, departments, regulating bodies, and disbursement agencies which we refer to as the government.

Self-Defeating Rules

Government buying policies, the need for checks and cross-checks, rules and regulations, and goodness knows what else—all in the name of making the most effective use of the taxpayer's dollar—have in many cases slowed down our military competitive lead and in some cases provoked long-term waste and inefficiency. Even worse, government buyers, following given purchasing policies, and acting in the best interests of the government, must seek to buy most efficiently—usually meaning at the least cost. They are not allowed, and are frequently completely unable, to purchase high quality if it costs more now, even though such purchases will save many dollars later.

As a consequence, the rules of the game cause them to purchase the least expensive items which will just—just barely—meet the required specifications. This also holds, somehow, for the esoteric subject of R&D activities. To do otherwise, I am assured, would require endless justifications, paperwork, etc.

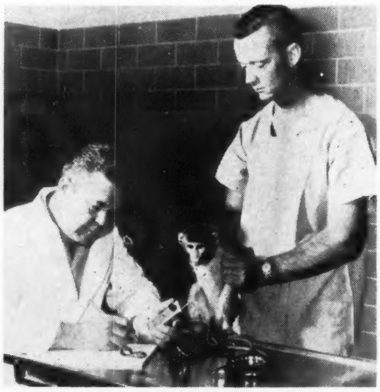
These policies inadvertently penalize superior quality and discourage efforts to promote true craftsmanship with concurrent attainment of reliability. Yet these are the two most important characteristics that all hardware must possess if we are to be successful in our space missions.

The problems do not stop here. A maze of technical and other government groups exists which must consider and pass upon the needs of civilian and military agencies in the performance of their long-range objectives. As a result, we have seen the establishment of committee upon committee, and scientist upon scientist, who must sit in on evaluation after evaluation, to the point where it seems that there are a thousand people in parallel and series combinations who have to be satisfied and possibly absolved before any really new concept, idea, weapon, or system can be officially blessed for movement to some procurement action. Furthermore, any one of dozens or individual specialists can, by suitable utterance or lack of utterance, kill a whole program at birth.

There is more! Money available is finite, always too little, and hardware and facilities that have been started usually must be kept going. When, oh when, will supporting research funds be made available in proper proportion to hardware funds? And how long will we have to wait to witness the assured continuity of R&D funding? Under present tight-money conditions, selectivity of program and directed orientation of activity could tax the capability of even the wisest people in the land. Furthermore, since government contracting is on a budgeted year-to-year basis, any government activity, military or civilian, which costs more to stop or abandon than it would to keep going for a single year, is likely to be kept alive forever, independent of its lack of utility. Heaven knows how much good money has been thrown after bad.

It gets worse! Procurement policies involving both competitive and proprietary proposals are occasioning a tremendous waste of the nation's creative talent. Studies show that 10 to 20 proposals are normally submitted in response to a single invitation to bid on a major weapons system. It is not uncommon for firms to assign nearly 10 per cent of their technical staffs—the top 10 per cent in fact—to this function. The creative manpower lost in those proposals that are unaccepted is alarming! Many steps can

Space Medicine Menagerie



One of the new facilities at the AF Aerospace Medical Center, Brooks AFB, San Antonio, Tex., is a veterinary service that selects, trains, and conditions animals for experiments associated with space projects. Left, an opossom gets an eye examination from veterinarian George Anstedt; right, chief of veterinary services, Col. Harry Gorman, checks monkey's heart with the aid of a tiny monitor, produced by National Cylinder Gas Div. of Chemetron Corp., which gives a "beep" with each heart beat.

be taken to improve this situation. The number of firms solicited can be cut down. Less elaborate proposals can be encouraged. Better interchange of information between industry and the government buying agency can be used to discourage unnecessary proposals, etc.

The list continues! Any representative of the Goliath of American industry will tell you the DOD system is like a gigantic bowl of wet noodles. Trying to get something done is like pushing on one end of any of the noodles. No one knows where the noodle is connected, where it goes in the mess, and what, if anything, will move.

Since we cannot win in the world's space sweepstakes without the complete participation of the Goliath of American industry, we must examine its competitive possibilities, its strengths and weaknesses. American industry is our principal source of technology. Everyone agrees we shall not in the future do all of those astonishing things in space with our present technology. New technology will be needed, it is agreed, but we could do an awful lot better than we are, and an awful lot more than we have, if what we had worked properly.

There is a gnawing fear that the wonderful economic climate in which we live, and in which American industry has grown to its present status of prominence, contains in it some basic factors which will not allow us to achieve our ends as rapidly or as effectively as we must.

American industry is geared to mass markets. Industrial changes must therefore be justified in terms of economic return. Capital expenditures, new tooling, and the costs of all items related to bringing out a new product are all carefully considered from the point of view of how many units will be sold and what the return will be per unit.

By these rules, American industry, flourishing in an atmosphere of free enterprise, has been able to accomplish near miracles. By tapping an extraordinary wealth of natural resources, it has brought to the level of the ordinary working man products and services today, at an attainable price, that even the wealthiest kings could not have gotten before, for any amount of money. The perseverance of our industry has substituted the household appliance and the automated machine for the slaves of the past. It has been a truly magnificent development.

But this type of economy produces its own brand of progress. Progress which is justified on the basis of return from mass market sales is cautious progress, or progress by inches. Too new an idea, too far a movement forward for mass desires, too good a device—one that won't wear out soon enough—and financial chaos may occur.

Progress by inches isn't going to win our technological race. What we need is progress by miles!

For this kind of progress, shelter is needed—shelter that can only come from the investment of "patient money." Indeed, the bolder the step forward, the greater the patience required, and usually the greater the cost. Truly significant technological improvements which ignore investments in manufacturing machinery and cannot be justified by mass-market return must therefore find other means of support. Such dramatic technological improvements cannot usually be justified on conventional economic terms and can therefore only be justified on grounds such as the vital need for defense purposes, etc.

Even so, can an industry steeped in the economics of mass marketing really rise—even with proper support—to change its ways from progress by inches to progress by miles? Not without a lot of inertia being wrung out of it.

The Fountainhead

The crying need is for American industry to bestir itself. It requires further education on the importance of science as the fountainhead of technology, and an understanding of the role of scientists. All too frequently, still, research is considered a toy or, even worse, a product quality-control service. It is not seen in its true light—as a creator of knowledge, wealth, and power. Without a proper understanding of research as a function, and without real technological understanding on the part of management, many companies do not even recognize new ideas of significance that arise, or, when they do, do they have the courage to convert them into reality.

The situation I have tried to describe is serious. None of us is clever enough to come up with all the answers. However, it is clear that we will have to mate patience and progressiveness in our thinking on a special time scale and pull together if we are to avoid a truly catastrophic impasse in attaining future goals. Furthermore, we have to guard ourselves against being lulled to sleep again by an occasional success or two.

The storehouse of fundamental knowledge must be refilled now, not later. This is no time for lengthy debates and procrastination. The race is on. Every shred of capability must be made available for the task facing us. We must tell the story of science and technology and its role in keeping us free wherever necessary. We must continuously pound on all sources which can help make more understanding flow in every element of our government, industry, and military, so as to discourage inefficiency and waste of our *intellectual resources*.

Finally, it is clear that we must all try to bring about closer cooperation and a closer association among the three groups with which we have been concerned here if the era in which we live is not to become the age of American atrophy. The common denominator to our ills is you and I, not some vague system. We, both as individuals and collectively, must take action—action based on affirmative answers to some simple but specific questions:

Do you believe that the force of science and technology is one of the most profound available for social progress?

Do you believe that the scientific revolution clearly demonstrates that, regardless of its system of government, a nation can experience material abundance if it possesses resources and knowhow?

Do you believe that we are entering an era in which what goes on in the R&D labs of a nation outweighs and is more important than what happens in Geneva, or Washington, or Wall Street?

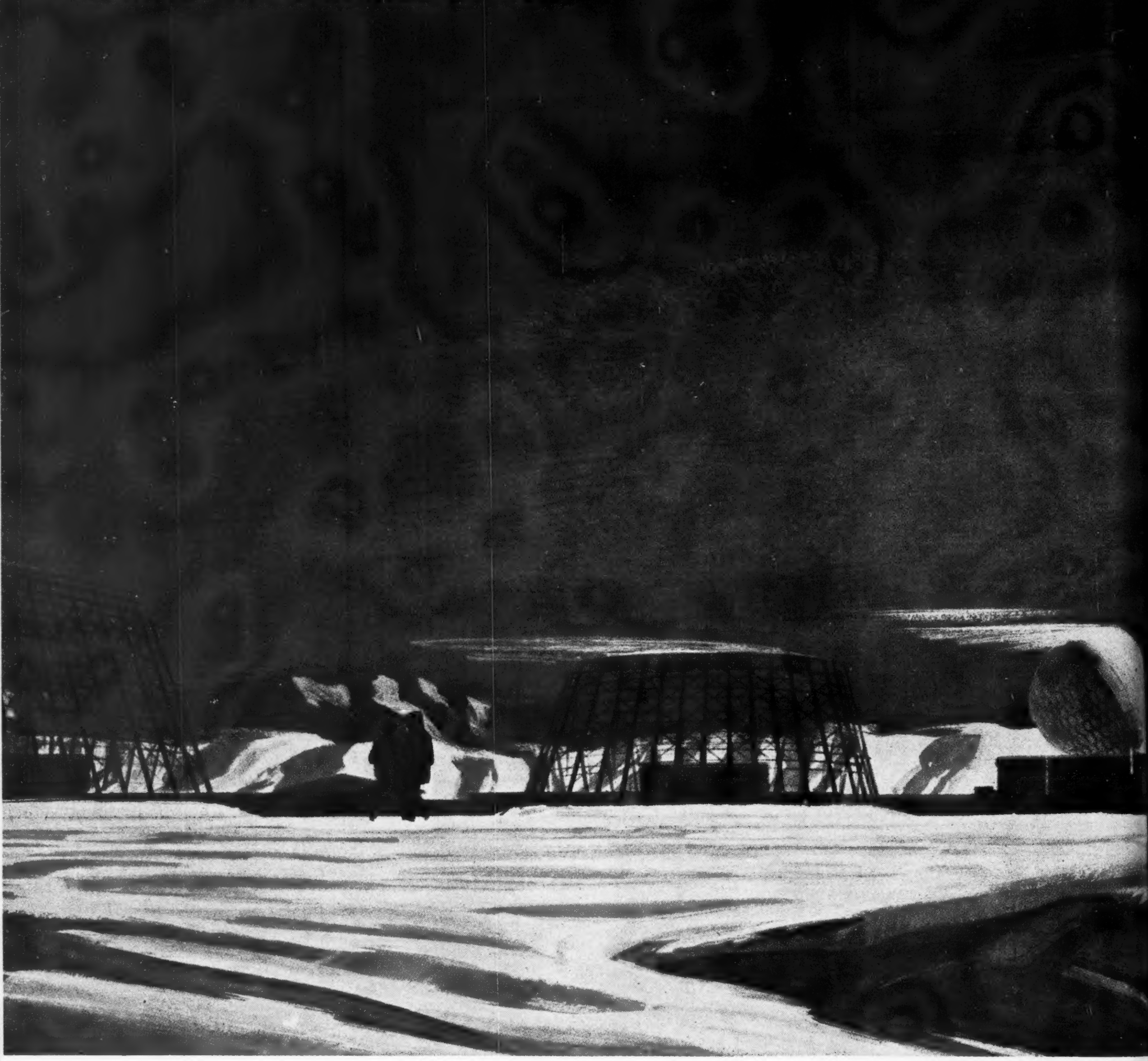
Do you believe that science today has become a political force, and that Einstein is replacing Lenin?

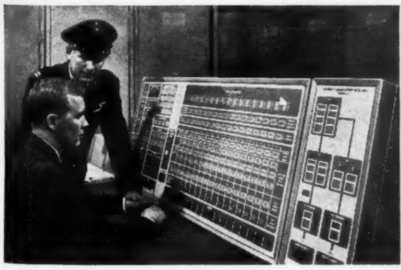
If you believe, tell that story. Do your utmost to insure the fact that the conquest of space *does* become a national symbol, and that the best possible integration of brains and brawn is utilized to outdistance any competitor in the race for technological supremacy in space.

Only by such superior technological achievements do I feel sure that we will be able to attain world peace. ♦♦

Europeans Plan Space Talks

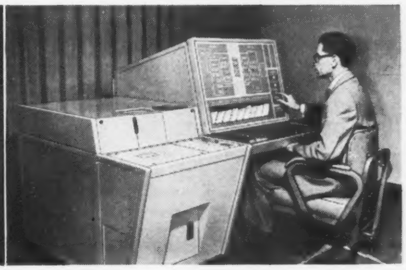
British Government groups will ask West Germany, France, and Italy to consider the use of the Blue Streak booster for satellite launching in a joint space program if a tentatively scheduled conference on space research among these nations comes off early this year. This conference and proposal are under attack by British Conservatives, who charge that they abuse Commonwealth countries, such as Australia and Canada, while merely giving away information on British rocket developments to the foreign governments.





The Central Automatic Monitoring Console displays the status of the entire site, and displays equipment degradation prior to failure.

The Checkout Data Processor generates simulated missile attacks and evaluates the BMEWS response to the simulation.



The Automatic Monitoring Console displays degradation and the location of degraded equipment.

ASTRONAUTICS Data Sheet — *Propellants*

Compiled by Stanley Sarner, *Flight Propulsion Laboratory Dept., General Electric Co., Cincinnati 15, Ohio*

RED FUMING NITRIC ACID (RFNA)

RFNA is a mixture of nitric acid and N_2O_4 with some water content allowed. Tolerances on composition as given by Mil-N-7254B are provided in the bottom table for both the "inhibited" and "uninhibited" acids. Due to the NO_2 present, RFNA is dark red in color and has a characteristic irritating odor. RFNA has less tendency to decompose than WFNA, and is preferred in most cases for this reason.

Hazards

RFNA is very corrosive and may cause severe chemical burns. Protective clothing requirements include rubber hood, apron and boots, and acid-handling gloves. Canister-type gas masks are questionable due to the presence of NO_2; hence self-supplying masks are recommended. Flushing with large amounts of water, followed by medical attention, is recommended when contact does occur.

Due to the NO_2 present, as well as its corrosiveness, RFNA is fairly toxic. The color of the fumes or the discomfort encountered is no indication of danger. Concentrations of NO_2 of 50 ppm may cause little discomfort, but are dangerous even for short periods. The maximum allowable concentration in air for an 8-hr day, based on the NO_2 content, is 5 ppm.

Materials for Handling

The use of 0.5 to 1.0 per cent HF as an inhibiting agent in RFNA reduces the corrosion of stainless steel and aluminum to a negligible amount. In general, aluminum (types 3003, 1060, 1100, 3004, 6061, and 5052) is good from ambient temperatures to about 120 F (types 2014, 2017, and Dural to 100 F), and stainless steels (types 347, 303, FA-20, 19-9 DL, 19-9DX, 321, and 304) are good to higher temperatures. Since RFNA is mainly used with HF inhibitor, high silicon irons should not be used. Titanium or its alloys should be avoided as they present an explosion hazard when in contact with RFNA.

Suitable nonmetals include Teflon, Kel-F, polyethylene, Genetron plastic HL, compressed asbestos, fluorolube, perfluorocarbons, and Nordcoseal 147-S. Each lot of lubricants should be checked for nitratable contaminants.

Cost and Availability

RFNA is readily available from several suppliers in drum lots at about 10¢ per lb.

Physical Properties of RFNA

Boiling Point	60 C	140 F
Freezing Point	−52 to −60 C	−61 to −76 F
Vapor Pressure* at 25 C (77 F)	0.180 atm	2.65 psia
at 45 C (113 F)	0.522 atm	7.68 psia
Specific Gravity at 60 F(Mil-N-7254B)	1.562 = 1.573	
Density** at 0 C (32 F)	1.593 g/cm³	99.45 lb/ft³
25 C (77 F)	1.551 g/cm³	96.83 lb/ft³
45 C (113 F)	1.515 g/cm³	94.58 lb/ft³
Viscosity** at 0 C (32 F)	1.99 centipoises	
at 25 C (77 F)	1.249	
at 45 C (113 F)	0.909	

* Composition: 84.6% HNO_3; 13.4% N_2O_4; 2.0% H_2O.
** Composition: 84% HNO_3; 14%, N_2O_4; 2% H_2O.

Chemical Properties of RFNA*

Heat of Formation	
Liquid at 25 C	−638.10 cal/g
For $HNO_3 \cdot 0.1141\ N_2O_4 \cdot 0.0833\ H_2O$ (M. Wt. = 75.016)	−47.868 kcal/mole
Heat Capacity at 20 C	26.7 cal/mole-C
Maximum Allowable Concentration in Air (based on N_2O_4 content)	5 ppm

* Composition: 84% HNO_3, 14% N_2O_4, 2% H_2O.

Theoretical Performance of RFNA*

Fuel	Specific Impulse (sec) Frozen Flow	Specific Impulse (sec) Equilibrium Flow	Chamber Temperature** Deg K
N_2H_4	277	283	3083
RP-1	258	268	3230
UDMH	267	276	3222
Ethyl Alcohol	249	256	3000
Aniline	251	—	3200

* P_c = 1000 psia; P_e = 14.7 psia; optimum O/F ratio.
** Corresponds to equilibrium flow impulse.

Composition of RFNA (Mil-N-7254B)

	III-Uninhibited Per Cent	IIIA-Inhibited Per Cent
HNO_3	82.0–85.0	81.3–84.5
N_2O_4	14 ± 1.0	14 ± 1.0
H_2O	2.5 ± 0.5	2.5 ± 0.5
Total Solids	0.1 max	0.1 max
HF	—	0.6 ± 0.1

COMPÚTENCE . . . TOTAL COMPETENCE IN COMPUTATION

. . . provides effectiveness for new system of mobile defense against multiple airborne targets

The program: MAULER, U.S. Army's newest automatic-firing air defense system, involving missile-firing vehicles transported by air and parachuted into battle areas. **Basic Burroughs contribution:** design and production of the miniaturized electronic computer systems which will provide radar data processing and computation for MAULER. Among special design features will be the Burroughs Logi-Mod packaging technique, to protect sensitive computer components from shock during air transport and parachute drop. **Behind the news:** Still another vote of confidence in Burroughs Corporation's Compútence—total competence in computation—from basic research through production and field service to system management. Confidence in Burroughs performance, already proved in such vital programs as ATLAS, SAGE and ALRI.

Burroughs—TM

Mauler is being developed by Convair-Pomona, Convair Division of General Dynamics, for ARGMA, an element of the Army Ordnance Missile Command.

Burroughs

Burroughs Corporation

"NEW DIMENSIONS / in computation for military systems"

Lunar Surface Vehicles

(CONTINUED FROM PAGE 38)

degrading his working ability, mobility, and communications with the base.

Comparing spacesuit and capsule operations in these terms, we conclude that the capsule is lighter and more compact, has greater reliability, and can provide greater service than a spacesuit. The capsule would result in least atmosphere loss and would be more economical of vehicle space. In a capsule, the individual would not be so physically limited, and he would not develop insecurities resulting from the separation from the vehicle.

Individual spacesuits satisfying these conditions, even if preferred, will not be available, we believe, for a considerable time. Even were an adequate suit available, the over-all needs for sustained operation in a lunar environment could be far better satisfied by a capsule. It is recognized, however, that certain extraterrestrial applications may require spacesuits for short duration and special activities which might arise.

The capsule which evolved from these considerations is shown on page 37. In this view, the freedom of motion of the capsule and the capsule manipulators are indicated. These motions are controlled either directly by the capsule operator or remotely from a duplicate set of controls. The capsule can rotate ±180 deg about its vertical center line and 75 deg about its support point in the vertical plane of the boom.

The actuators attached to the capsule are provided with shoulder, elbow, wrist, and finger motion, as indicated by the dashed lines. The hand parts of the actuators are equipped with vise-like grips for holding and for the use of special tools, such as wrenches, hammers, drills, etc. The illustration on page 36 shows the capsule emplacing a nuclear-reactor element. Among its many functions might be removing obstacles, taking samples, making repairs on both vehicle and its base, transferring personnel, etc.

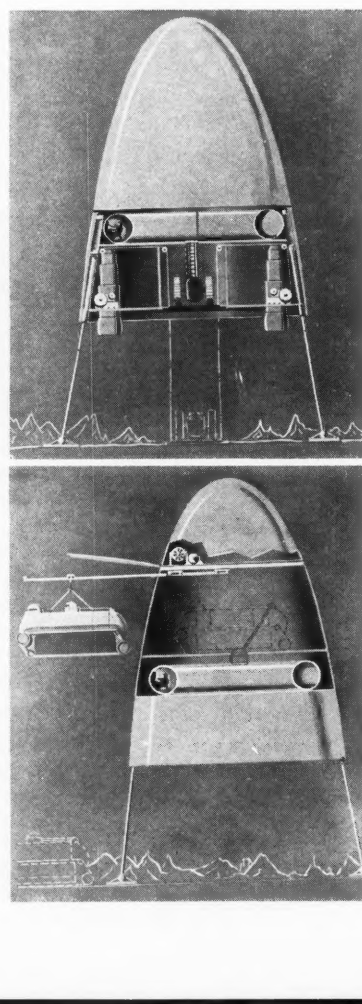
With this capsule concept, a family of lunar vehicles—robot, one-man vehicle, and three-man vehicle—can be studied in terms of an integrated program. The robot utilized in the early Moon landings can be simply a capsule modified for automaticity, fitted with tracks for locomotion, and given a small powerplant. The one-man vehicle can be a manned version of the robot, as suggested by the illustration on page 37.

Such a one-man vehicle might prove useful in early phases of lunar operations. Reduction of capacity and range results in low vehicle weight. The capsule, in the traveling position, lies within the track outline so that the vehicle remains mobile should it be overturned while traversing rough, undulating terrain.

The final unit in this family would be a three-man vehicle—one man in the capsule, one man operating the vehicle, and one man covering controls, instrumentation, and communications. This vehicle could have the capability of being away from the base for a period of three days with a total travel distance of 50 mi. Its design and operation will reflect many factors.

To begin with, it will have to be designed for minimum weight and envelope. Advantage must be taken of materials with maximum strength/density ratios, distributed so as to give maximum load-carrying capacity for given structures. Complete advantage cannot be taken of the lower gravitational force on the Moon, since vehicles must be built and tested on Earth; and since mass does not change, dynamic analyses must conform to the normal Earth pattern, modified for the reduced weight. The cabin layout, however, will be influenced by the low lunar gravity. Protection from the high and low temperatures and high radiation must be provided. A highly reflective, multiple-skin shell offers one feasible solution. Airlocks for entry and exit will constitute a special problem. The temperature extremes and high vacuum will require an extension of the state of the art in the design of the external seals and joints.

Schemes for Disembarking Vehicles



Necessary Life Support

For a three-man crew to function effectively during a 72-hr period away from base, adequate life-support facilities must be provided, including atmosphere of the proper composition, pressure, and temperature, sufficient nutrients, and potable and utility water. The following items could be included in the vehicle for this purpose:

1. A compression-distillation unit for regenerating potable and utility water during normal operation.
2. Stored water for supplying makeup and emergency potable water or emergency oxygen.
3. Stored oxygen for makeup and emergency oxygen supply.
4. Hydrogen-reduction electrolysis system for regenerating normal breathing oxygen.
5. Liquid nitrogen for supplying inert gas to crew chamber.
6. Refrigeration for storing food and solid waste.
7. Human waste collection system.
8. Food warming unit.

Separate air-conditioning and purification systems would be provided in the capsule and vehicle.

To maintain a livable environment, factors such as acceleration, radiation, noise, vibration, confinement, isolation, and detachment must also be considered in the design of the vehicle.

The powerplant of the lunar vehicle will constitute one of the major problems involved in its design. This powerplant must be capable of operating independently of an air supply, be of light weight and low volume, require a minimum fuel supply, and be extremely reliable. A nuclear powerplant, although having a high initial weight, can operate for a considerable time on just a few pounds of fuel. However, shielding requirements may be excessive. Alternatively, both hydrogen-peroxide engines and engines based on the diesel fuel-oxygen cycle—with their very much lower plant weight but high fuel requirements—

are possibilities. Fuel cells or chemical batteries may also be applicable, assuming a considerable advancement in the state of the art. Solar-energy systems coupled with liquid-metal turbines might be applicable for day use.

Considerable work is being done currently on non-airbreathing powerplants, including lightweight nuclear plants. Selection of an optimum plant for lunar application will require careful evaluation of existing programs and development of the specific plant.

Design of locomotion in the lunar environment without detailed terrain information constitutes a formidable problem. Types of locomotion suitable for assumed lunar terrain features are illustrated on page 37. Shown in the middle photo on that page are a tracked vehicle for irregular and fissured surfaces, a steel-wire-wheel equipped vehicle for handling thermal extremes, and a vehicle riding on low-pressure rollers for negotiating soft or extremely fine dust layers. The bottom photo shows a walking-beam action.

Of course, these are artist's concepts. All types of locomotion should be investigated in any study and an integrated combination evolved furnishing maximum reliability.

There are a number of other major design areas—manipulators, communications, observation, etc. Manipulators for a capsule will involve complex kinematic and control problems. Suitable protection for bearings, joints, and other exposed components must be provided. Suitable controls and drives, safe-travel limits for shoulder, arm, wrist, hand, and grip motions, and high reliability throughout must be assured. Adequate feedback sensing will have to be incorporated.

Provision in the vehicle design should be made for communications between vehicle and capsule, between vehicle and lunar base, and other surface and spaceborne vehicles, and between the vehicle and Earth under emergency conditions. Signals by radio, telephone, hand, and light, both visible and ultraviolet, are possibilities. Maximum miniaturization will be required to save space and weight.

Radar, television, headlamps, telescopes, and photographic equipment can be employed in the vehicle system to aid in observation and perception. Visual impediments such as local extremes of illumination, terrain obstructions, and restricted line of sight (because of smaller curvature of the Moon) are some of the problems to be resolved.

The usefulness of a lunar-surface vehicle will depend upon its ability to navigate over the lunar surface with a minimum expenditure of fuel and life-support materials.

The safety of the crew will be determined by accurate predictions of fuel consumption and elapsed time. Hence, a reliable method of navigation is essential. Possible methods to be considered are trail markings, radio-beam, and sidereal navigation. A base-oriented system is desirable.

Methods of controlling and driving the various operating components of the vehicle must be evaluated. Manually operated motions should be employed, where feasible, to conserve power and to facilitate emergency actions. Instrumentation should be selected on the basis of minimum weight and maximum reliability.

Boiling down our tentative thinking on these matters, we arrive at a design approach represented by the illustration on page 38. The top capsule, previously discussed, is attached to an articulated boom which provides access to any point within a 40-ft radius of the vehicle. The body is approximately 12 ft long by 10 ft in diam and weighs about 10,000 lb empty and 15,000 lb fueled. A hydrogen peroxide and diesel oil internal-combustion engine powers the vehicle. The controls for both the vehicle and for the capsule operation are located in the upper righthand compartment of the vehicle. Observation ports are located at the operator's position and in the rear of the vehicle. The space below the operator's compartment serves as the communication center.

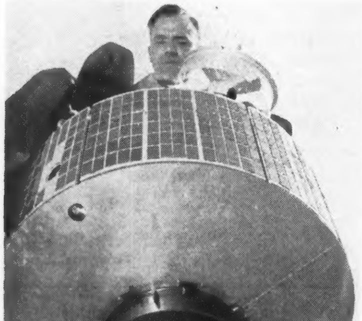
The rear of the vehicle is equipped with an airlock for transferring materials or equipment from the vehicle to the capsule or from the lunar surface to the vehicle. A cable-laying device rides in the rear of the vehicle. The table on page 38 gives a weight breakdown of the vehicle. These are order-of-magnitude figures only.

Concepts for stowing the surface vehicles in the spacecraft and techniques for landing on the Moon are indicated on page 52. The one-man vehicle in the stowed position is mated with the space-vehicle living quarters by an airlock allowing operator access to the capsule. Upon landing on the Moon, the operator enters the operating capsule, and then lowers the vehicle to the lunar surface by cables. The operator returns to the base in the reverse order. The three-man vehicle is similarly stowed in the space-vehicle nose cone. To land on the Moon, the manned surface vehicle is translated sideways until clear, and then is cable-lowered to the surface.

In summary, these ideas seem to us achievable. Many difficult problems remain to be solved and state-of-the-art advances are required in several areas. Assuming the eventual placing of a base on the Moon, development of lunar surface vehicles would seem a necessity, to be undertaken in a timely fashion, so that they will be ready when required. Only in this way will we be able to exploit to the fullest a successful landing on the Moon. ♦♦

Communications Satellite For 24-hr-orbit Experiment

Based on their development of this 32-lb satellite, Hughes Aircraft has proposed a test as early as next fall of telephone and television transmission via a 24-hr, earth-period orbit. NASA's Scout would be the delivering rocket.



Hughes engineer J. C. Meyer inspects the 2700 solar cells girdling the 32-lb satellite.

The Hughes approach employs a "pancake" transmission beam sufficiently directive to permit spin-stabilization of the satellite. A single-pulsed gas jet makes orbital adjustments. These two features keep the satellite quite simple mechanically and very light.

The electronics package, which includes a dual communications and guidance repeater, an UHF command receiver, and telemetering (L-band) transmitter, weighs 5 lb, including the weight of the system's traveling-wave tube.

Positioned above the mouth of the Amazon River, the satellite could link Europe, Africa, and the Americas. It would require the use of very large antennas on the ground for receiving and relay transmission for telecommunications.

The true scientist, the creative engineer,

buy. Since this is a realistic world, money is an important

of attainment—does not begin and end with his pay

and creative climate—to rub elbows with men who are

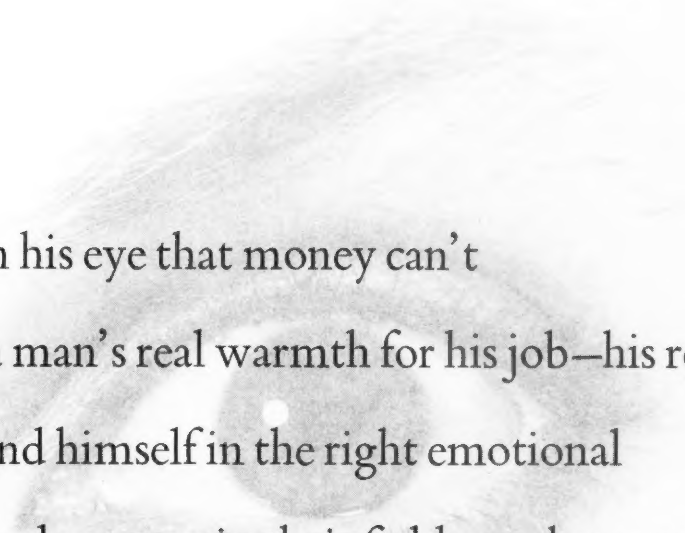
participant in the Great Adventure of Tomorrow

these rewards-within-rewards impel men of outstanding

For here they can work on the POLARIS FBM;

and on new, advanced contributions to the Space Age.

they find a sense of being, of doing, of accomplishing.



ASTRONAUTICS Data Sheet — *Materials*

Compiled by C. P. King, *Materials and Process Section. The Marquardt Corp., Van Nuys, Calif.*

WROUGHT COBALT-BASE ALLOYS

Cobalt-base materials were suggested for gas-turbine applications more than 50 years ago. These materials were in cast form and had good strength and resistance to oxidation up to 1500 F. From such alloys, lowering of the cobalt and increasing the nickel contents produced the wrought material group, which is in wide use today for high-temperature components in rocket, ramjet, and turbojet engines.

Fabrication

All the cobalt alloys have good ductility at room temperature and in sheet form are readily spun, stamped, or drawn. For severe forming, intermediate anneals may be required. Forgeability is good. Machining is not difficult providing carbide tools, heavy feeds, low speeds, and ample coolant are employed.

Joining

Weldability is good by any of the conventional fusion or resistance welding methods. High-temperature brazing is used very successfully on these alloys.

Availability

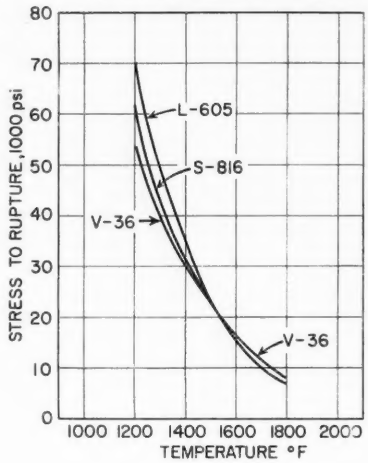
In the cobalt-base group, L-605 is the most widely used of the alloys. It is available as sheet, strip, plate, bar, rod, wire, tube, and forgings and has an extensive history of valuable usage. S-816 is supplied in sheet, plate, bar, and forgings. V-36 is primarily a sheet alloy.

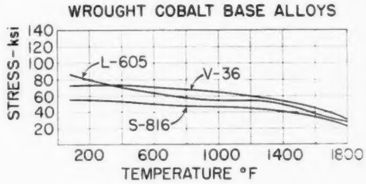
Heat Treatment

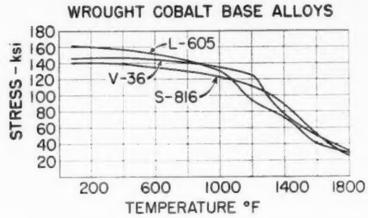
All three of these cobalt alloys are solution-treated between 2225 and 2275 F and rapidly cooled (air or water). They are usually worked and used in this condition; however, an aging treatment at 1400 F for 16 hr is sometimes employed to improve creep-rupture properties, especially at the higher temperatures.

Applications

Turbine blades, combustion chambers, turbine rings, afterburner parts, and blast deflectors are typical components which have been fabricated from the cobalt alloys.







Chemical Composition of Wrought Cobalt-Base Alloys

Alloy Designation	Co	Cr	Ni	W	Si	Mn	Fe	Mo	Cb
	Composition, Per Cent								
L-605	51	20	10	15	1.0	1.5	1	—	—
S-816	44	20	20	4	0.7	1.5	3	4	4
V-36	42	25	20	2	0.4	1.0	3	4	2

Physical Properties of Wrought Cobalt-Base Alloys

Alloy	Density	Coefficient of Thermal Expansion 10^{-6} in/in/F				Thermal Conductivity Btu — ft/sq ft/hr/F		
Designation	lb/cu in.	70–200	70–1000	70–1600	70–2000	400 F	800 F	1200 F
L-605	0.330	6.83	8.02	9.06	9.84	7.1	10.0	12.5
S-816	0.313	7.20	8.00	9.02	9.71	8.7	11.1	13.0
V-36	0.303		Not Available				Not Available	

CUT ALONG THIS LINE

Ritchey, Pickering

(CONTINUED FROM PAGE 31)

Pendray brought together a distinguished panel headed by Murray Snyder, DOD Information Officer.

The Wednesday luncheon produced a provocative address by Dr. Zarem (see page 24) and the presentation of ARS Fellow Memberships to seven distinguished figures in the field—W. D. Rannie of JPL; Alfred J. Eggers of NASA's Ames Research Center; Bernhard H. Goethert of ARO, Inc.; Thomas F. Dixon of Rocketdyne; Willis Hawkins of Lockheed's Missiles and Space Div.; Mortimer Rosenbaum of Convair-Astronautics; and George D. Colchagoff of ARDC.

The afternoon brought four more technical sessions, plus a special session devoted to "Space Age Planning: 1961–70," which produced eight papers dealing with marketing and contracting.

After-Dinner Effects

Post-Honors Night Dinner celebrations notwithstanding, Thursday morning produced four more technical sessions, including a panel discussion of the recent ARS Power Systems Conference and a session on commercial applications of missiles and spacecraft. The morning was also marked by the Annual ARS Student Conference, at which the two award-winning student papers were presented and a panel discussed professional job requirements and opportunities in astronautics, and by another session, new to ARS meetings, an advertising and public relations workshop.

Toastmaster at the Thursday luncheon was Irving Michelson of the Illinois Institute of Technology, Chairman of the ARS Education Committee. The luncheon speaker was Martin Summerfield of Princeton Univ., Editor of *ARS Journal* and ARS Board Member (see page 24).

The meeting closed with three additional technical sessions that afternoon, including a panel discussion of "Future Expectations in Space Flight," moderated by Abraham Hyatt of NASA, and the first ARS Student Chapter Delegates Conference.

Certainly one of the high points of the meeting was the Astronautical Exposition, held in the Shoreham Exhibit Hall, December 6–8. The impressive show, exhibiting the latest components, equipment, and hardware produced by 89 of the nation's leading companies in the rocket, missile, and space field, was marked by a registration of more than 1350 people, and was constantly jammed with scientists and engineers anxious to learn a little more about the products shown.

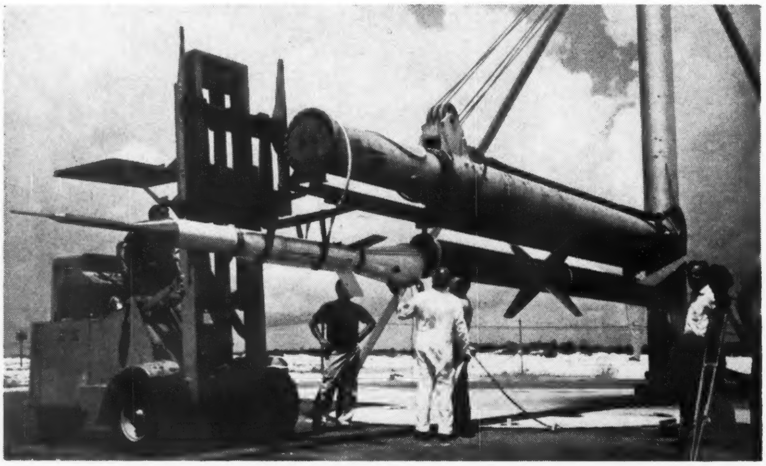
While it would be impossible to cover all of the ARS standing and technical committee meetings held during the week, a few highlights are worthy of mention.

At a meeting of the ARS Youth Program Committee, headed by Vincent S. Haneman Jr., Dallas consultant, and Laurel van der Wal of STL, Jim Gunkel of Douglas reported on Phase III of the youth education pilot program now being conducted in the Los Angeles area. He noted that 80 youngsters in the area are now attending a series of 40 lectures on rocketry and astronautics being given in four different districts in 20 sessions on alternate Saturdays. The series will culminate in term projects, results of which are to be exhibited at the Joint ARS-IAS Meeting in Los Angeles in June. The Committee also produced a new ARS policy statement (see page 28) which was approved by the ARS Board.

At the Program Committee meeting, it was announced that ARS would hold two national meetings and 10 specialist conferences in 1961, with the year culminating in the ARS SPACE FLIGHT REPORT TO THE NATION at the New York Coliseum, October 9–13. This meeting will be preceded immediately by the 12th IAF Congress, for which ARS will be host, to be held in Washington, D.C., October 2–7. It was also announced that the Semi-Annual Meeting in Los Angeles would be sponsored jointly with IAS at the Ambassador Hotel, June 13–17. New specialist conferences approved by the committee at the meeting were the ARS-ORNL Nuclear Applications in Space Conference, to be held May 3–5 in Gatlinburg, Tenn., and a Guidance and Navigation Conference, set for Stanford Univ., Palo Alto, Calif., August 7–9. The program schedule was approved by the Board at its meeting.

The Membership Committee recommended formation of an ARS Section Activities Committee, an action unanimously approved by the Board, and also recommended establishment of a new ARS membership grade structure, now being studied by the Board.

The Board also approved combining of the Communications and Control and Instrumentation Committees into a newly formed Communications and Instrumentation Committee; changed the ARS Education Committee from a technical committee to a standing committee; and approved formation of two new ARS committees, on International Affairs and Public Education. The Board also voted to make Immediate Past Presidents of ARS ex-officio non-voting Board members for a one-year period after being succeeded in the presidency. ♦♦



Cree-Ballute System Tested

Crew mates Cree test vehicle, having a 9-ft-diam "Ballute" fabric drag balloon and landing chute stowed in the container just aft of its tail fins, to two Nike boosters. The combination balloon-parachute system, being developed by Goodyear Aircraft for ARDC, and being evaluated for use in recovering nose cones, escape capsules, and orbiting vehicles, has successfully completed test firing to 150,000 and 170,000 ft.

Proton Radiation Hazards

(CONTINUED FROM PAGE 39)

human target. For protons, a large part of this information can be obtained computationally, if, in addition to the particle intensity, the energy spectrum of the incident radiation is known.

Such data have become available recently. They indicate, on the one hand, that the flare-produced additional proton flux undergoes complex changes in its spectra configuration as the intensity gradually drops to normal. On the other hand, it seems entirely sufficient to limit the discussion to one representative spectral model in order to bring out the basic differences in the depth-dose pattern as compared to the proton beam in the inner Van Allen Belt.

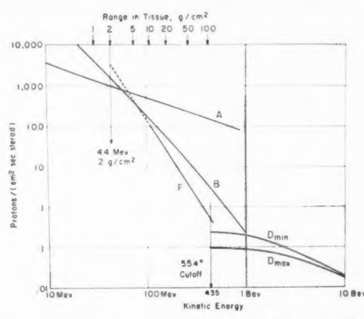
Such a representative spectrum, as measured by Ney, Winckler, and Freier after the giant solar flare of May 10, 1959, is shown in graph at right under F. It is based on balloon observations at 10 g/cm² pressure altitude. This means that the spectrum is verified experimentally only down to an energy of 110 mev. The extrapolation further down to 44 mev is indicated by a broken line. It has to be realized that the observations were carried out in Minneapolis at a geomagnetic latitude of 55.4 deg. The geomagnetic cutoff for the ordinary cosmic-ray beam at that latitude is 435 mev. That means that the flare-produced proton flux is in a forbidden energy interval. This phenomenon finds its explanation in the fact that during the measurements, 33 hr after termination of visible activity on the solar disk, an intense magnetic storm was in progress, allowing low-energy protons to enter freely without geomagnetic cutoff. The strong flare-produced flux of low-energy protons was observable at Minneapolis only during the magnetic storm, whereas observations of ionospheric disturbances in the polar region indicate that at higher latitudes large proton fluxes were incident continuously during the 33-hr interval.

During the large flare of Feb. 23, 1956, observations of the neutron intensity at different altitudes and geomagnetic latitudes within the atmosphere had been made that permitted an indirect determination of the extra-atmospheric proton spectrum. Bailey compiled these data and proposed the spectral model shown under B in the aforementioned graph. Since its slope is not greatly different from that of Spectrum F, the following analysis is based solely on Spectrum F.

Curve A in the graph shows the proton spectrum in the Van Allen Belt. Its implications for the dose distribution in a human target was discussed by the author in the July 1960 *Astronautics*.

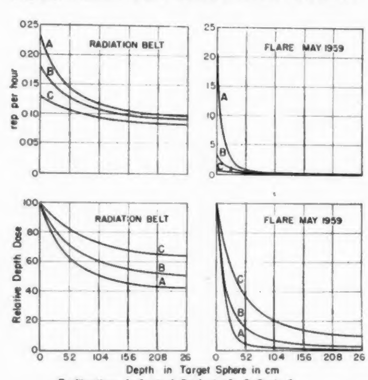
In the meantime, additional information has established the spectrum down to 10 mev, corresponding

Differential Energy Spectra of Proton Radiation Fields in Space



A: Protons in inner Van Allen Belt. F: Proton flux observed 33 hr after giant solar flare of May 10, 1959. B: Theoretical spectrum based on observations during giant solar flare of Feb. 23, 1956. D_{min}: Proton component of ordinary cosmic-ray beam at times of solar minimum. D_{max}: Same at solar maximum. Note much steeper spectral slope of flare-produced protons causing similarly steep slope of depth dose in human target. See upper abscissa scale for ranges in tissue.

Depth of Penetration of Flare-Produced and Van Allen Belt Protons



Shown are absolute and normalized depth-dose rates in spherical tissue phantom of 52-cm diam (75-kg weight). Note much steeper drop of depth dose for flare-produced protons. Intensity in Van Allen Belt holds for its lowest fringes. Flare-produced intensity has been measured 33 hr after termination of flare. Maxima in center of belt and during flare are at least several hundred times larger.

to a range in organic material of 0.14 g/cm². The main limitation of the A-Spectrum comes from the fact that it is based on recordings at altitudes not greatly exceeding 1200 km. This means that it is representative only for the lowest fringes of the inner belt. The maximum particle intensity of the inner zone at about 3000-km altitude is at least several hundred times higher than the values of Curve A in the graph. A still greater uncertainty rests in the fact that the exact configuration of the energy spectrum at the center is not known.

The upper abscissa scale in the graph shows ranges in tissue aligned with kinetic energies on the lower scale. A comparison of the two parameters reveals the very large intensity changes that occur within the range interval of interest for a human target. The bulk of the particle flux has a rather low penetrating power, indicating that the depth dose in the human body will show a steep drop. A full appraisal of these effects requires quantitative analysis of the dosage field in an appropriate tissue phantom.

The set of graphs shown below gives the results of such an analysis for a spherical tissue target of 52-cm diam (75 kg). The upper two graphs show actual dose rates for the proton beam of the Van Allen Belt and for the flare-produced radiation, assuming three different shield thicknesses. The lower graphs show normalized dose rates in order to bring out more clearly the effect of different shielding on the relative depth dose. The increase in penetrating power due to heavy shielding is especially pronounced for the flare-produced radiation because of the steep negative slope of the energy spectrum. The dose rate in the center of the target (expressed in per cent of surface dose) drops from 64 per cent for the beam in the Van Allen Belt with heavy shielding to 0.6 per cent for the flare-produced radiation with light shielding.

Human Target—Really Complex

Realizing that intermediate types of spectra between the two extremes of the Van Allen Belt (Curve A) and the Flare '59 type of radiation (Curve F) will occur, one sees how complex the problem of a quantitative assessment of the actual radiation load in a human target really is. In terrestrial radiation-safety practice, such highly structured dose distributions in the human body are quite unusual. Around reactors or cobalt-60 installations, the residual radiation outside the shield is heavily filtered and shows but little attenuation within the human

body. In proton-radiation fields in space, basically different conditions prevail. In the near vacuum of free space, no inherent pre-filtration of the source exists at all. Furthermore, local shielding by vehicle walls or construction material will always be small because structure will be at a premium.

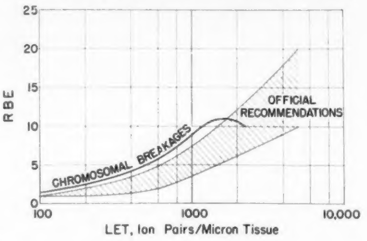
Computation of the actual exposure in rep requires multiplication of dose rate by exposure time. This evaluation is basically different for Van Allen Belt and flare-produced radiation. In the former, we are dealing with a radiation field limited in its spatial extension, yet unlimited in duration. In the latter, the radiation field fills interplanetary space, yet is of limited duration.

It is obvious, then, that the integral dose in the Van Allen Belt depends on trajectory and speed of the vehicle, whereas with flare-produced radiation the integral dose is determined exclusively by the time profile of the intensity surge itself. Observations of decay time during several flares indicate that the additional particle flux rises to a steep maximum in much less than an hour and then drops according to the $I_0/(t^2)$ law, where I_0 signifies the intensity one hour after maximum and t the time in hours.

Applying this relationship to the May '59 flare, one has to realize that the dose rates in the upper right-hand graph, page 62, were observed 33 hr after termination of visible flare activity on the solar disk. Extrapolation to the maximum right after onset of the flare would lead to a dose rate of some 10,000 r/hr for the surface dose behind 2 g/cm^2 of shielding and to 60 r/hr for the depth dose. Though these figures carry a large margin of uncertainty, because of the wide extrapolation, they do convey an idea of the order of magnitude of the radiation load from large flares. It is seen by inspection that for a t^{-2} law the bulk of the integral dose is administered during the first few hours after the maximum.

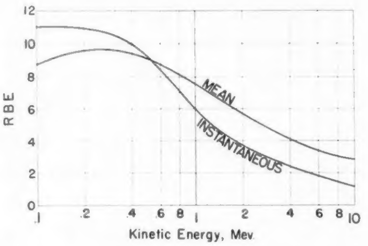
This picture is not strictly encouraging for man's flight into space. Astrophysicists are hopeful that methods of predicting large flares can be designed. Flares always occur in the vicinity of large spot groups and show a high rate of repeat occurrence in the same group. This might lead to statistical methods of forecasting. Such predictions would be limited, however, to periods of a few days at the most, since spot groups on the far side of the sun cannot be examined. Their former history with regard to flare activity, therefore, is unknown when they first appear on the visible side. As far as existing information permits

RBE of Protons as Function of LET



Shaded area: Recommendations of National Committee for Radiation Protection. Heavy Curve: Experimental data showing production of chromosomal damage with radiations of different LET.

Mean and Instantaneous RBE



For curve "Mean," abscissa signifies initial kinetic energy. Note that interval of high RBE is limited to energies about and below 1 mev.

conclusions, flares on the far side of the sun do not infest the wider vicinity of the Earth with radiation.

As mentioned, a complete dosimetric analysis of a radiation field requires determination of the RBE (relative biological effectiveness). For protons, this is of special importance, since low-energy protons show an LET greatly exceeding that of x-rays or gamma rays. The radiation-safety engineer in particular becomes apprehensive when protection requirements for protons are discussed as he remembers the provision of the Code of Federal Regulations, Title 10, Part 20: "A dose of 0.1 rad due to neutrons or high-energy protons . . . is considered to be equivalent to a dose of one rem." This indicates an RBE of 10 for "high-energy" protons. However, this rule cannot be applied to proton radiation fields in space, because the term "high energy" has quite a different meaning in the two cases. The Federal Regulations are issued mainly for assuring radiation safety in neutron-radiation fields around atomic reactors. In reactor terminology, "high energy" means one to several million e-volts as compared to the kilo e-volt range and below. In cosmic-ray terminology, "high energy" means the region of 100-million e-volts and beyond. The RBE values for protons in these two energy ranges differ greatly.

A discussion of the basic principles underlying the RBE concept and its limitations is beyond the scope of this treatise. As an official guide in radiation safety practice, the National Committee on Radiation Protection has issued recommendations listing highest and lowest values for the RBE factor as a function of LET. The shading in the graph at left indicates these values. The heavy curve in the same figure is a compilation of experimental data on the production of chromosomal damage with radiations of different LET. Admittedly, chromosomal damage is a very sensitive reaction of living matter to ionizing radiation.

RBE Computations

However, in assessing radiation-safety conditions, it seems advisable to base computations of RBE doses in rem on maximum sensitivity. By this rationale, the upper contour of the shaded area in the graph seems the best compromise and has been applied in the following analysis.

Converting LET to kinetic energy, one obtains the two curves shown in the graph at left. The RBE passes through a maximum of 11 at 0.15 mev and drops below 2 already at 5 mev. Before this relationship is applied to the proton spectra of the graph on page 62, the phenomenon of spectral degradation has to be discussed. If a heterogeneous proton beam penetrates an absorber, components of shorter range, that is, of lower energy, are eliminated earlier. This means that the local energy spectrum within the target is undergoing continuous changes. These changes can be easily derived by numerical analysis if the energy spectrum is known. Main interest in such an evaluation would rest on the low end of the energy spectrum, because it contains the particles of high LET and RBE.

The first graph on page 66 shows the results of the analysis for the F Spectrum of the graph on page 62. The F Spectrum has been chosen because of its extreme steepness, which indicates that it contains a much larger relative share of low-energy protons than Spectrum A. Comparing the degraded spectra of the first graph on page 66 to the top graph on this page shows that the mean RBE cannot greatly be in excess of 1.

It seems of special interest to compare these local spectra to the spectrum of neutron-produced recoil protons as it would be found in a hydro-

genous material (tissue) around a reactor. In the latter case, contrary to the situation in space, the primary radiation consists of neutrons which penetrate a human target easily and release recoil protons locally at all depths when colliding with hydrogen atoms of tissue. This mechanism explains why, even at great depths within the target, an intense local flux of low-energy protons can prevail. It is this same circumstance which accounts for the specific harmfulness of neutrons. These particles produce at any depth in a human target low-energy protons which for themselves have only a range of a few microns in tissue.

The quantitative aspects of this basic difference between neutron-produced and primary proton beams are presented in the bottom graphs. The ordinate of both graphs shows protons per mev expressed in per cent of total particle flux. The upper graph shows the so-called Watt Spectrum of recoil protons released by neutrons from thermal fission of U-235 in hydrogenous material, such as tissue. The lower graph shows the initial sections of the degraded spectra of the bottom graph on page 64. The profound difference between the neutron-produced and the flare-produced proton flux is obvious.

The RBE is greater than 1 only for LET values exceeding 100 I.P./micron$_T$. For protons, this corresponds to energies of about 10 mev and below. We can see, then, that the fraction of a heterogeneous beam for which the mean RBE will be greater than 1 will comprise the particles in the energy interval from zero to 10 mev. Since the LET changes considerably within this interval, the mean RBE will depend on the slope of the differential energy spectrum. The mean RBE of the total flux, in turn, will depend on how large a fraction the critical interval contributes to the energy of the total beam.

RBE for Intra-Target Dose

Carrying out this evaluation for the intra-target dosage fields and pre-filtrations, bottom graphs, page 62, one obtains a highest mean RBE of 1.65. This occurs in the surface of the phantom exposed to the F Spectrum behind the minimum shield of 2 g/cm^2. In view of the reassuring smallness of this value, a detailed presentation of the RBE transition for the other spectra seems of little interest.

The foregoing discussion indicates that the requirements for shielding against proton radiation in space cannot be concisely defined at the present time. More accurate data on the time profile of the intensity surges after solar flares as well as on their frequency of occurrence are needed. On the radiobiological side, more basic shortcomings exist in our present knowledge. Total-body exposures to omnidirectional beams of a heterogeneity as shown in the set of graphs on page 62 have not been studied with regard to their injurious effects.

Whatever the final method will be to determine the total radiation load in a human or animal target for this type of irradiation, little, if any, data are available which would assist in defining a permissible dose. Such a permissible dose would have to specify two parameters, namely, the total body radiation burden, possibly expressed in kg rem, and the local dose level in critical organs, such as the lens of the eye or testis tissue.

The need for such a distinction can be seen in the bottom graphs on page 62. Obviously, the same volume dose in kg rem, administered once in a flare-produced radiation field and once in the Van Allen Belt, would correspond to greatly different local surface-dose levels, for example, for the lens of the eye. These problems are all the more significant because, during flares, exposures close to and possibly fully entering the level of acute injury will have to be tolerated.

Generally speaking, it is obvious the exposure hazard in the Van Allen Belt is of comparatively minor importance. First of all, it is well defined and predictable if the trajectory of the vehicle is known. Furthermore, it can be easily kept at a level avoiding severe radiation damage with little compromise concerning trajectory and propulsion penalties. In this respect, it should be noticed that a heavier shield would be required for the Van Allen Belt than for flare-produced radiation, because of the much higher mean penetrating power of the protons in the Belt. This constitutes another good reason for disregarding protection in the Van Allen Belt in the design of shielding.

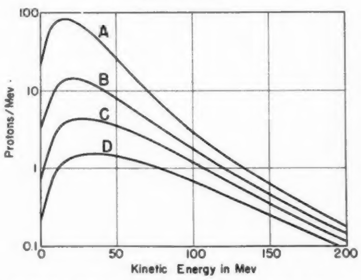
Suitable Shielding

The question of the most suitable material for shielding can be answered in a general way by pointing to the basic law that the stopping power for protons decreases slightly with increasing atomic number of the absorber. This would make liquid hydrogen or paraffin the most and lead the least efficient shielding material on the same weight basis. The weight penalty in replacing hydrogen by any type of plastics is quite moderate.

It might be mentioned in passing that these relationships do not hold for very high energies. Beyond the 200-mev level, the attenuation due to ionization becomes small and various nuclear interactions take over a larger share. Optimization of shielding in this region would require more complex considerations. They are of little interest here because the bulk of the total energy flux for the spectra in question is carried by particles well below 200 mev.

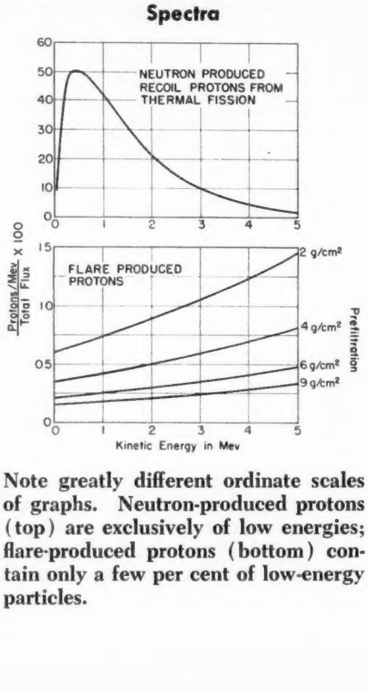
Selection of a material of low-atomic number for the outer shield would have the additional advantage of affording optimal protection against electrons also. Attenuation of electrons themselves is independent of atomic number. However, local Bremsstrahlung production in the

Spectral Degradation of Flare-Produced Proton Radiation Through Shielding

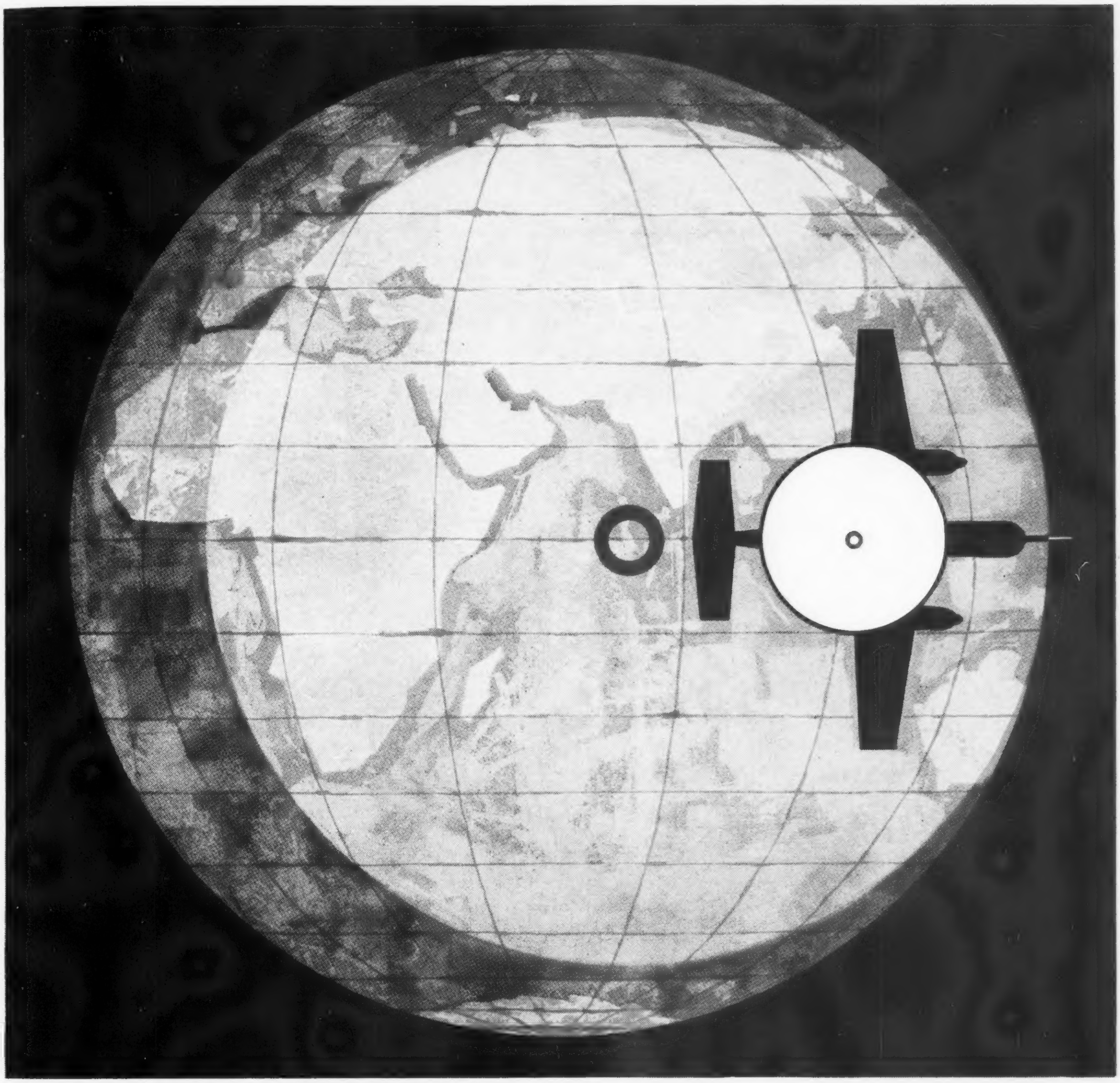


Curves show local spectra in target at different depths. Note basically different configuration of spectra as compared to incident beam shown in the graph at top of page 62.

Low-Energy Section of Intra-Target Spectra



Note greatly different ordinate scales of graphs. Neutron-produced protons (top) are exclusively of low energies; flare-produced protons (bottom) contain only a few per cent of low-energy particles.



NAVY

shield poses the main problem in beta-ray shielding, and this production is proportional to the square of the atomic number. That means it is considerably lower for low-Z material.

In view of the transitory nature of flare-produced beams, the problem of maximum protection with a minimum of weight could well be solved with a narrow compartment just large enough to accommodate a man, possibly even in a squatting position. Existing design proposals usually follow this line. Such measures will be necessary only for missions on which a quick emergency re-entry within about an hour is not possible. To what extent they will have to be provided on deep-space ventures of longer duration must not be decided today. By the time such journeys become technically possible, our knowledge of solar-proton fields in space will be greatly enlarged. ♦♦

Solar Power in Space

(CONTINUED FROM PAGE 35)

having an unmanageable rigid device with high accuracies, we only require an insulating thin sheet with a conductor on each side. If photoelectrons are emitted on the exposed side, then the current of electrons would be driven by the sunlight from the front to the back. The load impedance may therefore be connected between the two surfaces of the sheet and power will be made available to it.

The dimensions that have to be kept small because of the short hops of the photoelectrons would now be the size and spacing of the holes and the thickness of the sheet. In a practical case, these dimensions may be $^{1}/_{2000}$th of an inch for the thickness of an adequately strong plastic sheet, and $^{1}/_{200}$th of an inch for the diameter of the holes. The conducting surfaces on each side of the sheet can be made extremely thin. Metal evaporation films on plastic sheet are commonly only a few millionths of an inch thick and are good conductors of electricity.

Plastic sheet $^{1}/_{2000}$th of an inch thick is still a perfectly adequate insulator between the metallic films on each surface, and there would be no problem of short circuiting from one side to the other when potential differences of only a few volts are used.

By means of this trick, we have then made a thin metalized plastic sheet perform all the required functions. On one side, the surface is exposed to the sunlight and is so prepared as to emit photoelectrons. There is then a very closely spaced collecting surface held off with good insulation $^{1}/_{2000}$th of an inch away, still by the very same sheet. We then have the collecting surface in a position where, it is true, it is not quite so readily accessible to the electrons, but where, on the other hand, it does not obstruct the incident sunlight. All the functions of a photoemissive solar cell are being carried out by one sheet which is thin and flexible and which can be rolled or folded, and unfurled in space. It would not need to be accurately oriented and even a 30-deg misalignment would result in less than 15 per cent loss of power.

How big and how heavy would such a converter be for each kilowatt of power generated? It would obviously be rash to try and make accurate predictions as to what can be achieved, but even the approximate figures are interesting. If a total efficiency of only one per cent were achieved, and more detailed calculations show this not to be an unreasonable guess, then of the solar flux of energy of 0.16 watts/cm^2, 0.0016 watts/cm^2 would be put into electrical power. On one square meter, 16 watts would be generated.

A square meter of mylar sheet of $^{1}/_{2}$-mil thickness only weighs about 16 grams with the coatings and all, counting the area of the actual material only (not the area of material plus holes). Such a piece of sheet would therefore take up a region of 1.4 × 1.4 m.

1 Kw per Kg

On the basis of this estimate, one would have a kilowatt of electricity for each kilogram of sheet carried, that is 2.2 lb. The over-all figures would, of course, be a little lower if one takes into account the mechanisms required for unfurling large areas and for holding them out, and any additional electrical connections required to gather all the large current together at the spacecraft. If one takes all this into account and if one makes a more pessimistic estimate concerning the conversion efficiency, assuming that there are problems of a chemical nature in obtaining the best coating of the photoemissive surface, then it would still seem that 10 or 15 lb per kilowatt of power generated should be feasible.

If it is inconvenient for the space vehicle to receive its power at as low a voltage as would directly be generated, there is no reason why the sheet should not be divided into a number of areas that are electrically connected in series. The final output might well be arranged at 20 or 30 volts.

Large thin plastic sheets unfurled in space have been discussed for many purposes. Using radiation or gas pressures in space for propulsion, for example, has been mentioned, and very large radio antennas will certainly be constructed by such techniques one day. One thing there is plenty of in space is space. With no gravity and only extremely minute forces acting on objects, very large thin sheets can be held out and very slight effects can make them stay stretched out more or less permanently.

Plastic sheets can be unfurled from a folded or rolled up condition by flat plastic tubes that are inflated with gas, or they can be flung out by the centrifugal force of a rotating vehicle, or indeed in a variety of other ways. Large areas can be held out sufficiently rigidly again just by spin, or perhaps by such devices as inflatable tubes, coated internally with a plastic which is initially soft but which eventually goes hard, so that the tubes are still slightly rigid when eventually the gas has escaped out of them.

The Echo satellite, a great success, was a first attempt in the direction of using and unfurling large areas of thin sheet. There will be much more work in this field, and the engineering problems involved will in any case be settled. It would not seem impossible that for power generation a sheet of 30-meter radius might be used. Such a sheet would weigh about 45 lb and, on the basis of the more optimistic estimate, would put out about 20 kw.

It is true that there are still many problems to be solved before such a device can be made operational. Preparing plastic sheet with the correct coatings and punching a vast number of very small holes are substantial problems. But there is a lot to be gained from solving these problems and reaping a rich supply of electrical power for very little weight in future space exploits. ♦♦

Competition Underway For Guggenheim Fellowships

Graduate students who wish to compete for this year's 18 Daniel and Florence Guggenheim Fellowships in astronautics should file applications and credentials with the Guggenheim Jet Propulsion Center of their choice, at Princeton Univ., California Institute of Technology, or Columbia Univ. (Institute of Flight Structures). The fellowships provide tuition and stipends up to $2000.

ENGINEERING PLACEMENT INQUIRY

This card may be folded and sealed or stapled and mailed in complete confidence. It will enable the professional staff at Convair/Astronautics to make a preliminary evaluation of your background. A personal interview can be arranged in your city by appointment. Every completed inquiry will be acknowledged.

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ELECTRICAL ENGINEERING ☐ MATHEMATICS ☐
ELECTRONIC ENGINEERING ☐
CIVIL ENGINEERING ☐ PHYSICS ☐

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ARS news

Letter from Headquarters

THIS column is being instituted because—simply enough—ARS communication on Society matters needs improvement.

This never used to be a problem. In the "old" days—say, 1953—even a multilith letter from the President managed to get the word to the membership effectively, and the President himself could probably have read every letter that came into headquarters if he wanted to. At that time there were only 2200 members, 14 Sections, a nine-man Board of Directors, and the headquarter's staff consisted of two people. Also, everyone had a pre-Sputnik zeal for space flight.

Since no zeal hath more fervor than that which is scorned—and ARS was scorned by a lot of people in those days—the communications system was remarkably effective.

The zeal for space flight achievement is still very high today, but ARS is no longer scorned and there *is* a national space program. Thus, the fervor is apparently not as high as it was. This, and the fact that there are now 15 directors, 11 Standing Committees, 17,440 members, 53 Sections, 40 Student Chapters, 19 Technical Committees, and a 37-man headquarters staff, is why the functioning of ARS communications is more complex.

One obvious way to better our communications is by using *Astronautics* more effectively. So—we are hereby launching this monthly column to help all concerned keep posted on ARS as an organization—its objectives, its policies, its business aspects, its plans.

First Item: On the October ballot, 2030 voted in favor of increasing ARS dues from $15 to $20, but 2290 voted against it. Result: Referendum defeated.

Second Item: Geoffrey Potter, Membership Manager, reports that 1960 topped all previous years for membership increase, with 4861 new members. ARS had 17,440 members as of December 31, 1960, compared to 13,725 at the same time in 1959. Also, Member grade drops represented about 8 or 9 per cent (lowest of any Society we know of).

Third Item: The study made on an ARS headquarters building (January *Astronautics*, page 21) produced some interesting findings incidental to the idea of the building itself. Some 80 per cent of ARS members sampled have been in the Society under five years. The rate of return of questionnaires was one of the highest ever experienced by the fund-raising organization—38 per cent. About 25 per cent of those sampled belong to IAS, 12 per cent to IRE, 11 per cent to ASME. The mail sample went to 1500, 570 of whom replied.

Summary: A young Society membership (80 per cent belong less than five years) in an exploding field (4861 new members in 1960 alone) thinks enough of ARS services to maintain membership (92 per cent renew each year), but is not convinced that these services are worth $5 more a year. This in itself is ample proof that ARS communication needs improvement. More on this next month.

James J. Harford
EXECUTIVE SECRETARY

ARS and IAS Combine Mid-Year Meeting To Be Held June 13–16 on West Coast

The AMERICAN ROCKET SOCIETY and the Institute of the Aerospace Sciences have agreed to combine the ARS Semi-Annual Meeting and the IAS Summer Meeting into a joint meeting to be held June 13–16 at the Ambassador Hotel in Los Angeles, marking the first time two professional societies have combined two major national meetings.

The avowed purpose is to reduce the number of national technical meetings, unnecessary duplication of meetings, and the strain placed upon scientists and engineers confronted with numerous technical meetings each year.

The ARS-IAS Joint Meeting will include 26 to 30 technical sessions and cover the widest possible spectrum of subjects pertinent to airplanes, missiles, rockets, and space flight. Heavy emphasis is being placed on obtaining papers which forward the "state of the sciences" and the "state of the art," including new and original work in theory, research, development, and application.

Papers are specifically requested for the following technical sessions which have been established: Air Transport Logistics; Advanced Transports (Classified Session); Aerodynamics; Earth Landing Re-entry Problems (Classified Session); VTOL Systems; Program Status on Weapon Development Techniques (such as B-70, etc.); Structures and Materials; Aircraft Propulsion Systems (Classified Session); Aircraft Auxiliary Systems (Classified Session); Operations Support Equipment; Automation and Computer Techniques; Advanced Chemical Propulsion Systems (Classified Session); Applications for Vehicles and Satellites; Orbital Aircraft (Classified Session); Space Mission Simulation; Deep Space Vehicles; Progress Report on a Major Missile Program (Classified Session); Space Physiology and Performance; Space Operations and Maintenance; Space Interception Techniques; Planning for Success in the "One Shot Mission"; Attitude Control of Space Vehicles and Orbiting Satellites.

Papers are also requested in the following general areas (which have not as yet been broken down into specific sessions): Solid and liquid rockets; physics of atmosphere and space; space power systems; operation in foreign atmosphere; and others.

All classified papers submitted for review and consideration *must be unclassified.* The material should contain the author's name, organization, title, and an address where he can be reached.

Testing Conference Set for Los Angeles March 13-16

The many facets of missile and space vehicle testing will be explored at the ARS Missile and Space Vehicle Testing Conference to be held at the Biltmore Hotel, Los Angeles, March 13–16.

The program, organized under the direction of Bernhardt L. Dorman of Aerojet-General Corp., will cover guidance and navigation control, propellant handling, range operations, human factors, test facilities, and static testing. Sessions on flight testing, program experiences, high-altitude

On the calendar

1961

Feb. 1–3	**ARS Solid Propellant Rocket Conference, Hotel Utah, Salt Lake City, Utah.**
Feb. 16–17	Symposium on Recent Developments in Materials for Nuclear Applications, Univ. of New Mexico, Albuquerque.
March 9–10	Symposium on Engineering Aspects of Magnetohydrodynamics, sponsored by AIEE, IAS, and IRE, Univ. of Pennysivania, Philadelphia, Pa.
March 13–16	**ARS Missile and Space Vehicle Testing Conference, Biltmore Hotel, Los Angeles.**
March 20–23	IRE International Convention, Waldorf-Astoria Hotel and N.Y. Coliseum, New York, N.Y.
March 27–31	Symposium on Temperature—Its Measurement and Control in Science and Industry, Veteran's Memorial Hall and Deshler-Hilton Hotel, Columbus, Ohio.
April 4–6	**ARS Conference on Lifting Re-entry Vehicles: Structures, Materials, and Design, Riviera Hotel, Palm Springs, Calif.**
April 4–6	Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, co-sponsored by Polytechnic Institute of Brooklyn, IRE, IAS, and U.S. Defense Research Agencies, Engineering Societies Building, New York, N.Y.
April 12–13	Symposium on Information and Decision Processes, Purdue Univ., Lafayette, Ind.
April 18–20	Symposium on Chemical Reaction in Lower and Upper Atmospheres, sponsored by Stanford Research Institute, Mark Hopkins Hotel, San Francisco.
April 26–28	**ARS Propellants, Combustion, and Liquid Rockets Conference, Palm Beach Biltmore, Palm Beach, Fla.**
April 30–May 4	7th ISA National Aero-Space Instrumentation Symposium, Adolphus Hotel, Dallas, Tex.
May 3–5	**ARS/ORNL Nuclear Applications in Space Conference, Oak Ridge National Lab, Gatlinburg, Tenn.**
May 8–10	IRE National Aerospace Electronics Conference, Biltmore & Miami Hotels, Dayton, Ohio.
May 9–11	Western Joint Computer Conference, Ambassador Hotel, Los Angeles, Calif.
May 22–24	**ARS National Telemetering Conference, Sheraton Towers Hotel, Chicago, Ill.**
May 22–24	National Symposium on Global Communications, co-sponsored by AIEE and IRE, Hotel Sherman, Chicago, Ill.
June 13–16	**Joint ARS-IAS Meeting, Ambassador Hotel, Los Angeles.**
June 19–21	Heat Transfer and Fluid Mechanics Institute Conference, Univ. of Southern California, Los Angeles.
July 9–14	4th International Conference on Bio-Medical Electronics and 14th Conference on Electronic Techniques in Medicine and Biology, Waldorf-Astoria Hotel, New York, N.Y.
Aug. 7–9	**ARS Guidance and Navigation Conference, Stanford Univ., Palo Alto, Calif.**
Aug. 16–18	**ARS International Hypersonics Conference, MIT, Cambridge, Mass.**
Aug. 23–25	**ARS Biennial Gas Dynamics Symposium, Northwestern Univ., Evanston, Ill.**
Aug. 28–Sept. 1	International Symposium on Rockets and Astronautics sponsored by Japanese Rocket Society, Tokyo.
Aug. 28–Sept. 1	International Heat Transfer Conference, Univ. of Colorado, Boulder, Colo.
Oct. 2–7	**XIIth International Astronautical Congress, Washington, D.C.**
Oct. 4–6	American Society of Photogrammetry Semi-Annual Convention, Biltmore Hotel, New York, N.Y.
Oct. 9–14	**ARS SPACE FLIGHT REPORT TO THE NATION, New York Coliseum, New York, N.Y.**

simulation, and instrumentation and communication will also be included.

The technical program will be presented on the first three days in concurrent double sessions, with the final day devoted to field trips to Vandenberg AFB and the AF Flight Test Center. Three of the technical sessions—static testing, flight testing, and program experiences—will be classified under the co-sponsorship of the ARDC and Hughes Aircraft Co.

Those persons wishing to attend the classified sessions should return the clearance form mailed with the meeting program to all members by February 24. Additional forms are available on request from ARS headquarters.

In addition to the technical program, three luncheons are also scheduled. On Monday, March 13, Maj. Robert A. White, the Air Force X-15 test pilot, will be the luncheon speaker. Tuesday's speaker will be R. C. Semmons, assistant administrator of NASA, and Wednesday the luncheon will be addressed by Vice Admiral John T. Hayward, Deputy Chief of Naval Operations—Research.

This is the second meeting that ARS has held in the area of testing. In March 1959 the Society held a conference devoted to flight testing in Daytona Beach. It also held a conference last March in Detroit in the allied field of ground-support equipment.

The meeting was organized by the ARS Test, Operations, and Support Committee in conjunction with the ARS Southern California and Antelope Valley Sections. An outline of the technical program and luncheons follow.

Monday, March 13

GUIDANCE AND NAVIGATION CONTROL

9:00 a.m. — **Music Room**

PROPELLANT HANDLING

9:00 a.m. — **Ball Room**

LUNCHEON

12:30 p.m. — **Renaissance Room**

Toastmaster: Philip Fahey, President, Antelope Valley Section

Speaker: Maj. Robert A. White, Air Force Flight Test Center, Edwards AFB, Calif.

RANGE OPERATIONS

2:00 p.m. — **Music Room**

HUMAN FACTORS

2:00 p.m. — **Music Room**

Tuesday, March 14

TEST FACILITIES

9:00 a.m. — **Music Room**

STATIC TESTING
(CONFIDENTIAL)

9:00 a.m. Ball Room

LUNCHEON

12:30 p.m. Renaissance Room

Toastmaster: Thomas F. Dixon, Rocketdyne, Div. of North American Aviation, Inc., Canoga Park, Calif.
Speaker: R. C. Semmons, Assistant Administrator, National Aeronautics and Space Administration, Washington, D.C.

FLIGHT TESTING
(CONFIDENTIAL)

2:00 p.m. Ball Room

Wednesday, March 15

PROGRAM EXPERIENCES
(CONFIDENTIAL)

9:00 a.m. Ball Room

LUNCHEON

12:30 p.m. Renaissance Room

Toastmaster: Bernhardt L. Dorman, Conference Chairman
Speaker: Vice-Admiral John T. Hayward, Deputy Chief of Naval Operations—Research, Washington, D.C.

HIGH-ALTITUDE SIMULATION

2:00 p.m. Ball Room

INSTRUMENTATION AND COMMUNICATION

2:00 p.m. Music Room

Five More Companies Become Corporate Members

Five more companies have joined the growing list of AMERICAN ROCKET SOCIETY corporate members participating in Society activities. The companies, their areas of activity, and those named to represent them are, as follows:

Aerospace Corp., Los Angeles, Calif., engaged in general systems engineering and technical direction of missile and space systems, and research, engineering, and management relating thereto. Named to represent Aerospace in Society affairs are I. A. Getting, president; A. F. Donovan, senior vice-president, technical; C. W. Sherwin, vice-president, laboratories; J. H. Irving, vice-president, systems; and E. H. Barlow, vice-president, engineering.

Brunswick Corp. Defense Products Div., Muskegon, Mich., manufacturer of plastic rocket motor cases and plastic and bonded metal structures for rockets, missiles, and ballistic missiles. The company will be represented by H. J. Jacobi, president; L. A. Niedfeldt, general sales manager; W. G. Cox, chief engineer; J. F. Biehl, western sales manager; and H. E. Ennis, eastern sales manager.

CHANGE-OF-ADDRESS NOTICE

In the event of a change of address, it is necessary to include both your old and new addresses, as well as your membership number and coding, when notifying ARS Headquarters in order to insure prompt service. If you are moving or have moved, send the following form to Membership Dept., American Rocket Society, 500 Fifth Ave., New York 36, N.Y.

Name ____________________

Membership Card No. ____________ Coding ____________

Old Address ____________________

____

New Address ____________________

____

1961 ARS Meeting Schedule

Date	Meeting	Location	Abstract Deadline
Feb. 1–3	Solid Propellant Rocket Conference	Salt Lake City, Utah	Past
March 13–16	Missile and Space Vehicle Testing Conference	Los Angeles, Calif.	Past
April 4–6	Lifting Re-entry Vehicles: Structures, Materials, and Design Conference	Palm Springs, Calif.	Past
April 26–28	Propellants, Combustion, and Liquid Rockets Conference	Palm Beach, Fla.	Past
May 3–5	Nuclear Applications in Space Conference	Gatlinburg, Tenn.	Past
May 22–24	National Telemetering Conference	Chicago, Ill.	Past
June 13–16	Joint ARS-IAS Meeting	Los Angeles, Calif.	Past
Aug. 7–9	Guidance and Navigation Conference	Palo Alto, Calif.	March 15
Aug. 16–18	International Hypersonics Conference	Cambridge, Mass.	March 30
Aug. 23–25	Biennial Gas Dynamics Symposium	Evanston, Ill.	Past
Oct. 2–7	XIIth International Astronautical Congress	Washington, D.C.	May 1
Oct. 9–14	ARS SPACE FLIGHT REPORT TO THE NATION	New York, N.Y.	April 15

Send all abstracts to Meetings Manager, ARS, 500 Fifth Ave., New York 36, N.Y.

Firth Sterling, Inc., Pittsburgh, Pa., producer of high-temperature alloys and engineering alloys and sintered refractory materials for nozzles, entrance caps, and jetavators. Representing the company are R. K. Hopkins, vice-president and general manager, Steel Div.; R. E. Kimmins, sales manager high-temperature alloys; W. A. McKenn, chief metallurgist, Steel Div.; M. L. Backstrom, sales manager, special products; and J. C. Redmond, director, research and development, Carbide Div.

Geophysics Corp. of America, Bedford, Mass., engaged in research and development in the broad field of physics, geophysics, and astrophysics with emphasis on problems of the Space Age; engineering, development, and production of related instruments and prototype equipment; design and development of atmospheric and space plastic products; and manufacture of commercial laboratory and industrial equipment. Representing the company are John W. Bond Jr., manager, Physics Systems Div.; Robert M. Chapman, manager, Instrumentation Div.; Richard H. Braun, manager, VIRON Div.; Burton W. Wheeler Jr., manager, David W. Mann Co.; and Richard F. K. Herzog, manager, Ion Physics Dept.

Mycalex Corp. of America, Clifton, N.J., is a missile component manufacturing company producing high-temperature, high-reliability electrical insulation and telemetering switches of *Mycalex* glass-bonded mica, *Supramica* ceramoplastic, and *Synthamica* synthetic mica materials. Named to represent the company are A. S. Backus, vice-president, operations; Henry M. Richardson, vice-president and senior consultant; Willima Fondiller; F. A. Barr, chief project engineer; and Jerome Taishoff, president.

ARS-Stanford Univ. Sponsor Guidance & Control Conference

A two and one-half day national Guidance and Control Conference, under the sponsorship of the ARS Guidance and Navigation Committee, the Northern California Section, and Stanford Univ., has been announced for August 7–9 at Stanford Univ., Palo Alto, Calif.

The tentative session topics include: Classified sessions on ballistic-missile guidance systems, and gyros, accelerometers, and platforms (special two-session program); guidance computers, optical devices, radars, etc.; attitude sensing and control; guidance and control systems research; injection guidance, earth satellites, station keeping, rendezvous; planetary probes, solar probes, lunar-landing systems, etc.; exotic inertial components (cryogenic, electrostatic, etc.); and North-indicating devices, navigation systems for ships, submarines, and aircraft.

Anyone wishing to present a paper should submit the paper or a 300 to 500-word abstract, before March 15, to the Conference Program Chairman: Dr. Donald P. LeGalley, c/o Space Technology Lab, P.O. Box 95001, Los Angeles 45, Calif.

SECTION NEWS

Alabama: Among several talks given by him recently at NASA's Marshall SFC and at a Section meeting in December, guest lecturer **Helmut A. Abt**, associate astronomer at the Kitt Peak National Observatory, Tucson, Ariz., discussed "Astronomical Experiments in Space."

Dr. Abt opened his discussion by noting the three major limitations which the atmosphere places on astronomers making observations from the Earth: Spectral limits set by ozone and water vapor in the atmosphere; sky brightness which creates fogging of photographic plates used in astronomical observations; and poor resolution in sighting objects in space because of motion of the atmosphere.

These limitations can be largely overcome, he pointed out, by launching astronomical experiments into space beyond Earth's atmosphere, such as in these envisioned projects:

(1) An orbiting astronomical observatory composed of four separate telescopes to study stars, proposed by the Univ. of Wisconsin, and to be combined with the Smithsonian Institution's sky-survey program designed to produce star position and spectral catalogs of the sky.

(2) A 36-in. telescope for ultraviolet scanning spectrography, proposed by the Kitt Peak National Observatory.

(3) An experiment to study interstellar absorption lines, abundancies of the elements, and motion of gas clouds in space, proposed by Princeton Univ.

(4) A wide angle photoelectric photometer to study zodiacal light and view the Earth, proposed by Mount Wilson Observatory and the National Bureau of Standards.

(5) A spectro-scanning experiment proposed by Harvard Univ.

(6) Balloon experiments proposed by the Univ. of Colorado.

(7) Venus polarization studies pro-

posed by the Univ. of Indiana.

(8) A 24-hr satellite, proposed as a second experiment by the Kitt Peak National Observatory, and to be composed of numerous experiments from various astronomical institutions.

In conclusion, Dr. Abt gave a brief review of facilities at the Kitt Peak Observatory, which is supported by the National Science Foundation.

Antelope Valley: In a December meeting, a small group of members heard an informative and interesting talk by **H. L. Thackwell** of Grand Central Rocket on "Low-Cost All-Solid-Propellant Launch Vehicles for Large Orbital Payloads." A social hour preceded the meeting.

—Leslie O. Harrington

Chicago: Launching the 1960–61 Season with the annual President's Night Address in September, the Chicago Section embarked on a crowded schedule of 13 meetings in the 10-month program. An enthusiastic gathering of three score and ten assembled in the Officers' Club of Fifth Army Headquarters to hear 1960 ARS President **Howard Seifert** describe the "Headaches of the ICBM Program." Immediately preceding Dr. Seifert's lecture, **James Barnard** (Univ. of Michigan '64) presented a movie and sound track of his supervised experimental LPR firing, conducted by personnel of Purdue's Rocket Test Laboratory.

The October Meeting, held at the Chicago Engineers Club, featured **Pres Layton**'s address on "Jet Propulsion and Basic Research. **H. M. Drake,** assistant chief of NASA's Flight Test Research Div. at Edwards AFB, addressed a joint meeting of the ARS and IAS Chicago Sections in November; and the calendar year ended with a double-barrelled slide-and-film clip summary of "Problems Associated with High-Altitude Operation of Rocket Propulsion Systems" by **B. H. Goethert,** Director of Research for ARO, Inc.

—C. C. Miesse

Columbus: The year just completed by the Columbus Section was highly successful, both from the standpoint of the local membership and in terms of contributions to the Society nationally.

Our membership grew from 85 to 115, a 35-per cent increase. The second consecutive specialists conference on liquid rockets and liquid propellants was held in Columbus, with 336 attending. The Section continued affiliation with the Columbus Technical Council, which provides speakers to local high schools and science clubs and judges for the annual high school science fair. The Women's Auxiliary

ARS Tennessee Section Annual Dinner Highlights

At the Tennesee Section's annual dinner, held in December, members met their new slate of officers (above)—from left, Hugh Gardenier, vice-president; Ed Turner, secretary; L. T. Barnes, treasurer; and Harvey Cook, president for his second term—all of ARO Inc., in the AEDC Rocket Test Facility; (below left) saw fellow member E. K. Latvala, right, chief of ARO's aerospace research group, receive the Section's annual Igniter Award, presented by Joel Ferrell of the awards committee, for his outstanding contribution to the growth, technical programs, and administration of the Section during the year; and heard guest speaker of the evening H. A. Gorges, below right, NASA Marshall SFC Aeroballistic Div., discuss current investigations of the Saturn booster.

has continued to grow; its accomplishments include helping members become better acquainted, supporting activities at local conferences, and promoting the education of an outstanding local girl science student each year.

We look forward with confidence that the coming year will be at least as productive.

Members of the Section were guests of the Ohio State Univ. Graduate School in December at the new physics building on campus. Guest speaker for the evening was **G. C. McVittie** of the Univ. of Illinois (Urbana) Dept. of Astronomy and Observatory. Dr. McVittie's special professional interests include general relativity and its astronomical applications, dynamical meteorology, and gas dynamics. His topic was "Our Expanding Universe," which included a discussion of galaxies as a source of light and radio waves, the red shift as an indicator of the motion of recession galaxies, the meaning of the statement that the galaxies are uniformly distributed in space when they are viewed as objects in motion, and the picture that an astronomer on Earth would be expected to obtain of such a moving system of galaxies, compared with actual observations.

—James L. Harp and James A. Laughrey

Holloman: Some 100 members and guests attending the November dinner

meeting were introduced formally to the Section's new officers: H. J. Von Beckh, president (re-elected); Lt. Col. B. W. Marschner, vice-president (re-elected); H. H. Clayton, secretary (re-elected); and B. D. Gildenberg, treasurer. Dr. Von Beckh introduced the evening's guest speaker, **Hubertus Strughold,** who discussed Astrobiology, much along the lines of his paper in the December 1960 *Astronautics.*

—Harry H. Clayton

Neosho: The following new officers were presented to the Section at an installation banquet in December: D. B. Gore, president; D. E. Palmer, vice-president; R. G. Baker, secretary; and J. D. Baker, treasurer. Rocketdyne president **S. K. Hoffman,** an ARS director, officiated at the ceremonies and was guest speaker for the evening, discussing "Large Rocket Engines in Space."

—Russell H. Jensen

New England: The Section held its final meeting of 1960 at the Raytheon Missile Systems Div. cafeteria in December. Guest speaker **Robert C. Copeland,** research meteorologist for Allied Research Associates, Inc., described the Tiros satellite as a meteorological tool. Also, at this meeting, the membership was introduced to the following officers for the coming year: A. John Gale, president; J. C. Herther, vice-president; J. E. Lavelle, treasurer; and L. R. Michel, secretary.

—Warren A. Tucker

Pacific Missile Range: At a dinner meeting in October, attended by some 80 members and guests, guest speaker **Donald P. LeGalley** of STL gave "A Survey of Present Space Programs," aided by recent films and slides showing U.S. and U.S.S.R. space-vehicle data. Dr. LeGalley has had a long and distinguished career in rocketry, including 10 years with the Navy, in BuOrd and CNO's Office. In 1948, he participated in the first conceptual studies of the Navy missile now called Polaris.

At the annual dinner in December, outgoing Section President **Lyman E. Wood,** plans-coordination officer of the PMR Naval and Astronautics Center, and a staff member at Pt. Mugu since 1950, was presented a commendation and a plaque by **Rear Adm. J. P. Monroe,** PMR Commander, for his "untiring efforts on behalf of the scientific and engineering community of this Command . . . (and) significant contributions to the already high esprit de corps of our engineering staff."

Guest speaker of the evening was **Jules Lehman,** who flew to Calif. from Princeton, N. J., to give an illustrated lecture on the Tiros meteorological satellite program. Lehman manages the RCA Data Handling and Ground Systems Div.

Also at this meeting, officers elected for the coming year were presented to the members, as follows: J. E. Masterson, president; Lt. Comdr. J. E. Draim, vice-president; J. M. Pollard, secretary-treasurer; and A. Menken, membership chairman.

—Arthur Menken

Princeton: At the November meeting, attended by 85 members and guests, guest speaker **Capt. Robert C. Truax,** USN (Ret.), currently Director of Advanced Development of Aerojet-General's Liquid Rocket Plant, opened his talk with a startling prediction of routine scheduled flights from planet to planet, and proceeded to discuss in some detail the basis for his belief. The significance of bringing the cost of transportation per pound of vehicle to a reasonable level was covered in detail. The means of improving the efficiency of launching

ARS Southwestern Michigan Section

John D. Moeller, left, president of the new ARS Southwestern Michigan Section, receives the Charter from Charles W. Williams of Chrysler Corp. in ceremonies held recently at Western Reserve Univ.

vehicle and the carrying capacity of the payloads were also carefully considered. The novel suggestions for providing launching sites from vessels or from large bodies of water revealed how the speaker's background and training was projected to advance aerospace planning and complicated systems design. The slides used to demonstrate the various techniques discussed and to explain the engineering and cost factors involved made a convincing exposition of the subject.

—H. M. Gurin

Wichita: At the November meeting, guest speaker **V. S. Haneman** described the program of youth education which has been conducted by the Southern California Section. Several teachers from Wichita school system were present, and an interesting informative discussion followed Haneman's formal presentation.

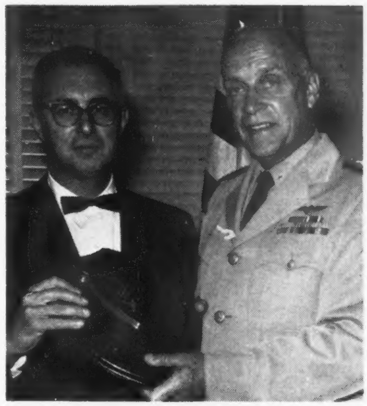
In the December meeting, the Section elected the following officers for the coming year: T. Taylor, president; R. J. Nyenhuis, vice-president; C. M. Long, secretary; and R. Holloway, treasurer.

—R. J. Nyenhuis

STUDENT CHAPTERS

California State Polytechnic College: The activities of the Cal-Poly Chapter last fall included talks on solid rocket propulsion from Aerojet-General, on Titan launcher system from the American Machine and Foundry, on instrumentation of the Atlas weapon system from Convair-Astronautics, and on the development and future of large rocket engines from Rocketdyne. On the lighter side, we attended an invitational showing of the movie, "I Aim at the Stars."

Navy Citation



Lyman E. Wood, retiring president of the ARS Pacific Missile Range Section, receives a plaque from Rear Adm. Jack P. Monroe, PMR Commander, "in recognition of his untiring efforts on behalf of the scientific and engineering community of this Command" during ceremonies at the Section's recent annual dinner.

Two of our activities for this year will be a field trip to Vandenberg AFB and a display at Poly Royal.

—Fred Marmie

Univ. of Oklahoma: At a meeting in November, guest speaker **Robert Gracely** of the U.S. Naval Ordnance Test Station, China Lake, Calif., gave a talk on problems of testing large rocket motors, particularly the Polaris booster. He supplemented his discussion with slides and pictures of test equipment and procedures. His presentation added much to our understanding of an area of rocket technology not familiar to most of us.

—Mike Ruby

Univ. of Washington: At a meeting in November, guest speaker **M. E. Maes** of Boeing's advanced-propulsion group discussed "Electrical Propulsion Systems." He covered two main areas: Power generation, primarily the nuclear reactor and thermionic converter, and thrust systems, such as ion, plasma, etc. Maes brought a rail-type pulsed-plasma accelerator and showed its operation with films. His presentation was interesting and enjoyable.

—Patricia L. Blake

CORPORATE MEMBERS

Aetron, a Div. of **Aerojet-General**, is a member of the joint team, Aetron-Blume-Atkinson, selected by AEC as architect-engineer-managers for the planning and possible development of the $100 million Stanford Univ. two-mile linear electron accelerator facility near Palo Alto, Calif. . . . **ALCOA**'s Rome Cable Div. has set up a new production unit, the Special Products Facility. The company's new Edison works, modern aluminum die casting plant, has gone on stream . . . **Chance Vought** shareholders have approved Chance Vought Corp. as the new corporate name.

Ford Motor's Aeronutronic Div. has changed the name of its Research Operations to Research Labs . . . Expansion at GE includes: Groundbreaking for a new refractory metals plant at Euclid, Ohio; plans for a new Advanced Computer Development and Research Lab at Sunnyvale, Calif.; and, a latest addition, a 465,000 sq ft

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Highlights at Cal-Poly Student Chapter

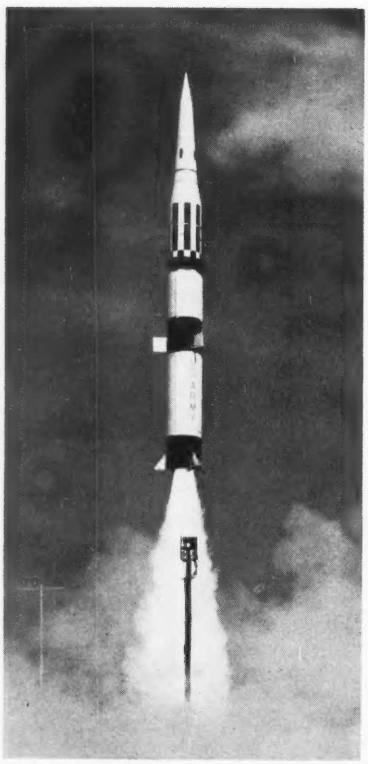
Left, Russel Kuehl of Aerojet-General (second from right) shows Cal-Poly officers a sample of binding material for solid propellants after a talk to the Chapter on propulsion technology. From left, Arrangements Committee Chairman Darrell Commings, Corresponding Secretary Larrey Collins, Vice-Pesident Al Colton, President Dan Hancock, Recording Secretary Lee Chapman, Russel Kuehl, and Program Chairman Ray Mercado. At the right, a portion of the Chapter's ARS display at the Poly Royal of April 1960; the display will be repeated this spring.

engineering and manufacturing facility at Syracuse, N. Y. . . . **General Dynamics** has been named to carry out a three-year $8.7 million development program of a nuclear plant of 300,000 to 500,000 kw electrical capacity for the Empire State Atomic Development Associates, Inc., (ESADA).

Hughes' semiconductor division has reorganized its product lines operations. Hughes and SABCA, a Belgian aircraft corporation, have formed a new company in Belgium, called COBELDA (Compagnie Belge d'Electronique et d'Automation) . . . **ITT Labs** and ITT Federal Div. have been integrated into ITT Federal Laboratories . . . **Lear** has announced formation of a new International Div., Santa Monica, Calif. . . . **Marquardt** is sponsoring a daily radio broadcast "Engineering Report," 7:35 to 7:40 a.m., over WRC-NBC in Washington, D.C. . . . **Minneapolis-Honeywell** has changed the name of its Marion Instrument Div. to Precision Meter Div. . . . **North American Aviation** announces that the name of its Missile Div. has been changed to Space and Information Div.

RCA has announced its entry into the production of custom-designed computer memory systems . . . **Radiation Inc.**'s Levinthal Electronic Products, Inc., subsidiary, has been renamed Radiation at Stanford (Calif.) . . . **Raytheon** has regrouped its government engineering, production, and marketing operations to better serve the aerospace field . . . Reorganization at **Telecomputing Corp.** includes: Combining of the Monrovia Aviation and Narmco Mfg. divisions into the Advanced Structures Div. with facilities remaining at Monrovia and La Mesa, Calif., and renaming of the Cook Batteries Div., Denver, Colo., to Power Sources Div.

Pershing Missile Shows New Configuration



The variable-range Pershing field ballistic missile shows its new configuration in a launching from transporter-erector at Cape Canaveral. The two-stage solid-propellant missile is being developed by the Army in conjunction with Martin-Orlando.

Arrowhead Section Sponsors Student Essay Contest

An essay contest designed to stimulate creative thinking about the Space Age by high school students is being sponsored by the ARS Arrowhead Section as part of its youth education activities. The subject of the essay will be "Why We Must Go into Space."

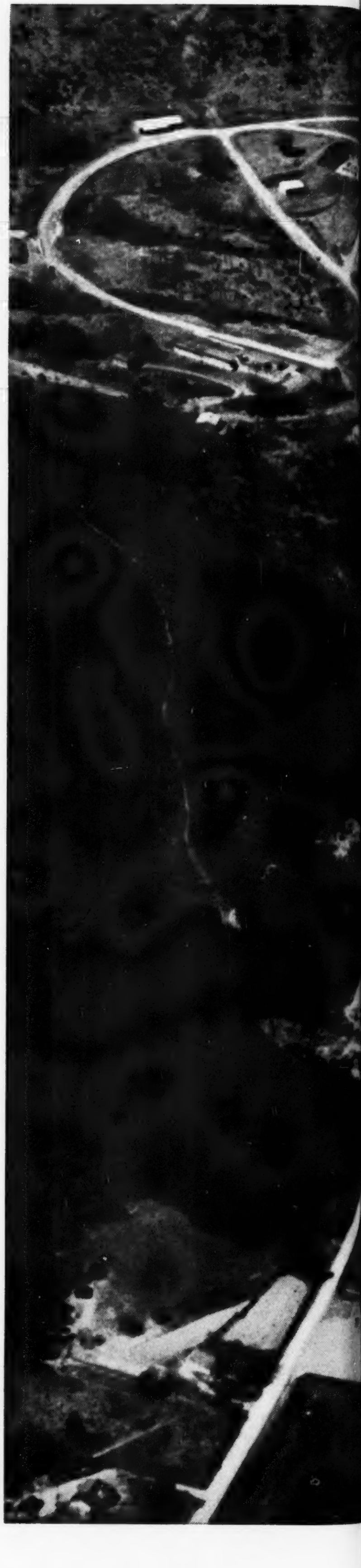
The ARS through this Section also recently sponsored the first Student Interest Days at Redlands, Riverside, and San Bernardino in California. A total of 120 senior high school students attended the meetings, where panel members discussed education and careers in the Space Age.

Soviet Meteorological Satellites?

A foreign news source reports that the U.S.S.R. plans to launch a chain of meteorological satellites into polar orbit. No dates were given.

Third Japanese Rocket Symposium Scheduled

The Third International Symposium on Rocketry and Astronautics will be held in Tokyo under the sponsorship of the Japanese Rocket Society, Aug. 28 to Sept. 1, 1961. Those wishing to present papers or scientific exhibits should send a 100-word abstract of the proposed material to Prof. T. Hikita, Engineering Faculty, Univ. of Tokyo, Bunkyo-ku, Tokyo, Japan, by June 10, 1961. Reservations for the meeting may be made through the Symposium Committee Office, Japanese Rocket Society, Yomiuri Newspaper Bldg., 1-3 Ginza-Nishi, Chuo-ku, Tokyo, Japan, until June 30.

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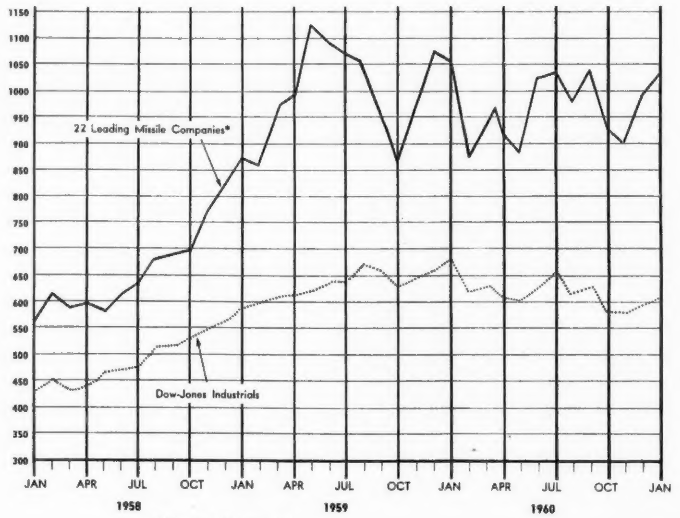
Missile market

By Jerome M. Pustilnik, *Financial Editor*

THE OBVIOUS is so rarely ignored in this solemn business of investing money that when a security analyst encounters an apparently attractive stock—obviously underpriced—he immediately becomes skeptical. The stock market is right and he is wrong, he warns himself. Sometimes, however, that often sought but seldom found sleeper, that "special situation," is uncovered.

National Research Corporation seems to be such a stock. Here is a 20-year-old scientific company, well-known and of excellent reputation, listed on the American Stock Exchange, directed by new management that is vigorous and profit-conscious, reporting higher sales and earnings for each of the last five quarters, and with further gains likely in the offing. Despite this, the stock sells for about half its 1959 high and not much above its lows of the last seven years.

Formed in 1940 to develop useful and profitable new enterprises through research, the company pioneered in high-vacuum technology. Out of its research also came such commercial developments as coated lenses, frozen concentrated citrus juices, penicillin production, blood-plasma preparation, high-purity steel alloys, and metalized plastics and paper. The company also set up an equipment division to design and manufacture and sell high-vacuum equipment.



*Index compiled June, 1955

	Jan. 1961	Dec. 1960	% Change	Jan. 1960	% Change
Dow-Jones Industrials	616	595	+3.5	679	−9.2
Missile Index	1036	980	+5.7	1059	−2.2

Although these developments were technically outstanding, NRC felt compelled to sell large interests in these projects because it could not finance them until they became commercial. Eventually the moneyed groups acquired control. Meantime, the company broadened its activities, establishing a metals division and begining to do research and development work for the government and others on a contract basis.

Today the NRC does business through three divisions. The Equipment Div., which contributes more than half of sales, makes and sells industrial high-vacuum equipment, such as pumps, gages, valves, and leak detectors; process equipment in which high vacuum is necessary—induction, arc, resistance, and electron beam furnaces, coaters, crystal-growing furnaces, and chemical-process equipment; and space chambers which simulate conditions beyond 500-mi altitudes for testing space vehicles and components. The division's own engineering staff, with a budget of four per cent of sales, strives to improve established products, develop new high-vacuum equipment, and to engineer special systems.

The Research Div., which has been the source of many of NRC's past technical accomplishments, works almost entirely on outside sponsored programs, many under government contract. The division's 100 people are engaged in such areas as: Ingredients for solid-fuel rockets, high-temperature materials for missiles and commercial uses; vacuum deposition of thin-film circuits; vacuum metalizing for protective and decorative purposes; advanced high-vacuum technology and instrumentation; and space environmental testing. Successful research in ultra-high-vacuum test chambers, for example, which operate at pressures as low as 10^{-10} millimeters of mercury—one molecule in 7.6 trillion of air—has led to the design, manufacture, and sale of chambers up to 3000 cu ft capacity, designed to operate at pressures of 10^{-8} mm Hg. Government agencies and industrial firms engaged in missile and space programs must simulate conditions of low temperature, high vacuum, and varying radiation to environmentally test their products as they strive for greater reliability. The Government is considering construction of large space chambers at several of its testing centers. Just a few weeks ago, NRC acquired a small California manufacturer of high-vacuum equipment. The purchase will provide regional manufacturing facilities in an area of rapidly growing demand.

The Metals Div. grew larger than

the Research Div. in 1960 and climbed from third to second place in importance among NRC divisions. It produces tantalum, whose unusual properties are of interest to the electronics, missile, chemical processing, and atomic energy industries.

Licenses are another source of income to NRC which receives royalties from companies in a number of different fields.

Varied Profit Potentials

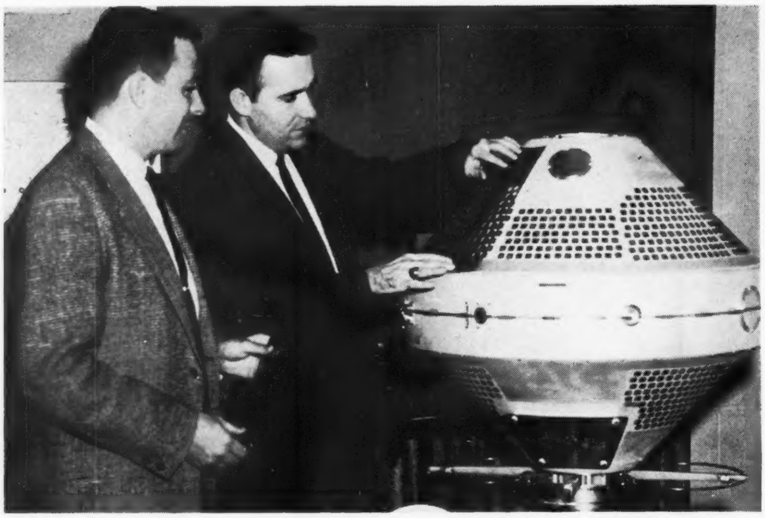
Under new management since mid-1959, the company began to capitalize on these varied profit potentials. Profit conscious, management's policy is to obtain the maximum return and growth from its existing divisions and to steer new developments into undertakings which it can finance. A significant turnabout in the company's earnings trend has been evident ever since. Earnings of between 45 and 50 cents a share should be reported for 1960 against only three cents a share the year before. This pattern should continue this year as sales rise over $10 million, while earnings range between 70 and 85 cents a share. Continued gains are likely in 1962.

Down more than 50 per cent from its 1959 high of $39^1/_2$, the stock certainly seems attractive. There are now outstanding four million dollars of 5 per cent subordinated debentures due July 1, 1976, and convertible into common stock at $23^1/_8$. These bonds are listed on the American Stock Exchange, as are the 526,098 shares of common stock. ♦♦

Kitt Peak Solar Telescope To Be Ready by 1962

Construction has begun on the unusual solar telescope planned as part of Kitt Peak National Observatory, Tucson, Ariz., under the sponsorship of the National Science Foundation. This telescope involves a 380-ft hole, 15 ft in diam, bored into the top of Kitt Peak as a reflecting cage, an image being shot against a mirror in its base from a heliostat tracking the sun from 110 ft above the ground. The image then reflects 280 ft to a mirror that delivers it to an observation room, where, as large as 34 in. in diam, it can be photographed or studied spectroscopically.

The Kitt Peak instrument will form images of the sun several times larger and more brilliantly illuminated than will any presently known solar telescope. It will be made available by NSF to all qualified scientists for research.



Drape Shape, Zoot Suit

Explorer VIII shows its temperature-controlling suit of 1300 half-inch checks of iron-oxide paint, nicely set off by silver paint and sandblasted aluminum. Together with some internal insulation and an internal coat of white paint, these keep the satellite's instrumentation between 32 and 122 F. Explorer VIII was launched Nov. 3, 1960, and stopped transmitting in December when its batteries ran out.

Danger Signs

(CONTINUED FROM PAGE 25)

insure the continuation of our position as a first-rank nation.

The first reaction of the average citizen to our cry of alarm might well be: I don't see anything wrong. Colleges and universities are getting along quite well. State appropriations for college systems have risen steeply in the last decade, private universities are successfully completing their ambitious fund-raising campaigns, professors are riding around the country in jet airplanes and living in first-class hotels, students are being given more opportunities for financial support and scholarship aid than ever before, and the government is pouring $460 million per year into the universities for the sponsorship of on-campus research.

Some Danger Signs

In short, the universities have never had it so good. Where is the problem? Why the alarm? In a nutshell, the danger signs that I see are the following:

Low staff salaries, particularly in the junior ranks, with consequent deterioration of standards of faculty selection.

Overemphasis on "consulting," that is, a second job, and the resulting diversion of attention from teaching and research.

Increasing preoccupation of the faculty with the raising of funds, at the expense of educational activity.

Unintentional corruption of scholastic standards by the contracting practices of the government and by the efforts of universities to get contracts.

The inversion of the ladder of professional standing, so that a contract-getting professor tends to rank above a scholar.

The distortion of the career aspirations of students who become convinced that the heart of research is contract negotiation, and that the purpose of a research paper is to impress a sponsor.

The closing off of certain areas of thought and discussion by the necessity of handling security information on campus.

The inadequacy of research and teaching facilities, an acute problem that contract money cannot solve.

Inadequate non-professional staff support and the resulting tendency to dissipate the energies of our first-rank faculties.

A growing imbalance between the peculiar prosperity of science and engineering on the one hand and the undernourishment of the non-science fields on the other.

A serious decline in the standards in colleges below the top five per cent, state-supported as well as privately endowed.

This list could be longer, but I think it is sufficient to indicate that the apparent prosperity to which our average citizen referred is not without its heavy problems; that the injection of nearly half-a-billion dollars in contract money into the universities may be a good way to buy the research that the government needs but a poor way to support education; that the universities have themselves to blame for the deterioration of standards more than the government; and that the problem of higher education is much broader than simply the support of research in science and engineering in the top 54 institutions that receive 90 per cent of the government money.

Low Salaries

Let me point to some of the sore points in our present practices, as I see them. First, despite the growth in pay scales in recent years, I believe faculty salaries are still inadequate and ought to go up from present levels by another 50 to 100 per cent, according to the individual case. The measure I use for arriving at this estimate is not how much we would like to have to please ourselves, but what it takes to enter the market for men of superior ability. I am not thinking only of the limited market among universities. I am thinking of universities as bidders for talent against industry, research institutions, and government departments and laboratories. We need not name names, but I believe we all know of vacancies on college staffs that were filled in the recent past by the best man available *for the low price* offered. I would prefer to see a college fill a vacancy with the best man, without this price qualification. When standards are sacrificed in this manner to economic expediency, the future of higher education becomes doubtful.

An immediate consequence of the low salary schedule is the widespread practice of "consulting." Years ago, consulting on the part of a faculty member was only an occasional thing, the main motivation being the desire of the faculty member to participate in an interesting program outside the university which would enhance his knowledge of his own specialty. The pay was nice, but he didn't have to go out looking for it.

This situation is still true for many of us, but for many, many others in university life, consulting has become a necessary second job. Without the

income from this second job, many a faculty member could not afford to remain in the teaching profession. Therefore, he must look actively for consulting work, and when one consulting job folds up, he must take positive steps to replace it with another. This pressure varies in intensity from one faculty member to another, depending on circumstances, but is especially compelling in the case of the lower-paid junior faculty.

The need for an outside income forces a number of professors into some projects that are even more directly aimed at getting money. Some have started businesses on the side, under corporate names designed to conceal their links to their universities; others are systematically engaged in other commercial ventures. There is no doubt that this kind of involvement in business interferes with the proper attention that should be given to students and lectures.

There are those who would say, if this sort of thing is going on, the universities ought to take steps to curtail such outside activities. Unfortunately, under present circumstances, such an attitude is not realistic. It is only by offering the combination package, salary plus consulting time, that universities can retain their most capable professors and attract other good men when openings develop.

Contract Research

Next, I want to direct attention to another area of financial need, the support of research. It is a recognized fact that universities have very little money "of their own" to finance research, while, at the same time, serious research is inconceivable today without strong financial backing, and serious advanced education is impossible unless accompanied by research. In our Aeronautics Dept. at Princeton, for example, the average annual budget is about $120,000 per faculty member. This happens to be about the sum I am responsible for. I don't propose this sum as a measure of what is needed in all fields, although I believe that this is exceeded in some areas, while it is far, far above the sums being spent in still other areas. Such research is financed largely by the Federal Government through contracts issued by DOD, the AEC, NASA, and other agencies.

To complain against Federal support of this magnitude may seem like gross ingratitude. When in the history of university research in America has research been supported more handsomely than today? Nevertheless, and despite public assurances to the contrary, this system of contract support is slowly but surely corrupting wide seg-

ments of our universities. I have no statistics to offer, and I have made no broad surveys. But I have had a great deal of experience in negotiating contracts with the government, and some experience in negotiating in behalf of the government—that is, as an adviser on the other side of the fence.

What would you think of a first-rank university that asks a government technical officer to help it find a physics professor for its staff who is a good contract-getter, no matter what field of physics, without asking about his teaching qualities?

I know of this case because I was asked to provide the nomination, and I know of others like it. Then there are the many, many cases of a professor who gets caught in a financial squeeze in his research projects—running short of money and facing the prospect of having to cut off the salaries of Ph.D. candidates on assistantship appointments—and hurriedly cooks up a proposal and goes out to "sell" it in order to save the careers of his students and avoid firing his technicians and research workers. Is this a case of thoughtful research under optimum academic conditions?

How about the wasted time of professors who have to make it a point to visit frequently at the AEC, DOD, NSF, etc. to get advance intelligence on the size of their next year's budgets, what subjects they are going to "buy" next year, and how much they will be able to "set aside for us?" What is the effect of a series of program terminations hysterically ordered by DOD, in the wake of Sputnik I in 1957, cutting off these and those fields of research in order to push more scientists into fields deemed important (in the minds of government technical people) for "overtaking the Russians," whatever that phrase means?

These are only a few aspects of a picture I regard with alarm—the tendency to measure a university's research staff by the size of its contracts rather than the new ideas of its staff; the elevation in academic stature of the contract-getting professor as against the scholar-professor; the distraction of the professor by the business worries of selling proposals, negotiating contracts and maintaining continuity of income, when he should be concentrating on his job as a teacher and scholar; the increasing influence on a university research program of government technical officers.

It is wrong for a university to compete with industry to secure government research contracts simply because its normal sources of funds are not adequate to cover its total educational commitments. The very nature of the competition tends to warp the objectives of a university laboratory, and to the extent that its research philosophy and attitudes begin to resemble those of its industrial competitors, to that same extent it fails in its true educational purpose. Companies frequently complain about this competition from non-profit universities that usually operate at lower cost, and in my opinion, their complaints are often justified.

The preceding discussion of faults I find in the present contracting system is designed to point out how the standards of our universities are declining as a result of their continually increasing dependence on defense contracts. I do not propose that universities should withdraw the research support they are equipped to give to DOD and other Federal agencies in their programs. I propose only that the services we offer the nation should not be identified with the irrelevant business of getting money for the university. The need for another source of support for university research, more intelligently channeled, is apparent.

The Non-Science Fields

Another consequence of the lack of proper financing for higher education—the last I will discuss—is the serious imbalance between the science and non-science departments. What we are doing to ourselves as a nation by virtually starving our faculties and students who specialize in the humanities, the arts, and the social studies is an outrage. The picture is the same everywhere. For example, in the sciences and engineering, no graduate student in a first-rank university need study for the Ph.D. without getting paid for it. And the pay is quite adequate, too, unless he is married, and many universities pay more than Princeton. The source, of course, is the contract money obtained from DOD, AEC, or NASA.

On the other hand, consider the graduate students in the non-science departments. Many receive no financial assistance, some of the best are given modest fellowships, and some are given a chance to earn some money as teaching assistants. But many are compelled by financial need to leave the university right after completion of the residence requirement to do their theses in absentia. We all know what this means for the quality of the thesis and what this loss of graduate students means to the faculty member's research program. I believe we all agree that the balance must be re-

Diamond Milestone

These are carat-sized diamonds, the first so large made by man, to be specific, GE Research Laboratory's pioneering research group on synthetic diamonds. The stones are imperfect mechanically and dark in color; but the large-diamond work is considered still in the early development stages by GE.

stored, that non-science education and research must be given proper support. But this will not come from DOD contracts, or at a sufficient level from the big foundations. Federal support, directly to the colleges and universities, by grant and not by contract, is indicated.

The logic of the situation is practically inescapable. The position of our nation in the world in future years will depend on the caliber of our leaders in all walks of life. These leaders—engineers, scientists, administrators, economists, legislators, writers, and diplomats—will have received their professional training in our colleges and universities, but these institutions are beset today by such serious financial problems that the quality of this training is beginning to be seriously diluted. Clearly, strong financial support is needed to provide them with the best possible education in order to guarantee our national survival.

The Government's Responsibility

If it is accepted that the problem is a national one, it becomes clear that neither private universities nor state tax-supported universities can be left to deal with the problem by themselves. The logical source of funds is the Federal Government, the only entity that can provide large sums for national purposes, and the only entity with a taxing authority commensurate with the job to be done.

With respect to private universities, obtaining the needed financial backing by traditional methods and from traditional sources is becoming increasingly difficult, and greater reliance is being placed on contract income to keep the university alive. Big donors are becoming more scarce in the present era of high income and inheritance taxes, and alumni are sometimes less than enthusiastic about meeting the steep expenses of modern education. As for state universities, only the most enlightened legislator can feel justified in voting large sums for the education of students who come from all parts of the nation, and, when graduated, return to the other 49 states to pursue their careers. In the present and future period of fluid mobility of students and educated professionals, the state university is really serving the nation and not merely the state.

To identify my position more clearly, it is my belief that direct Federal support is required, and in substantial measure. I visualize not merely more scholarships for good students, or merely more generous grants-in-aid of research, or simply bigger subsidies for those fields deemed essential to national defense, but direct across-the-board support of higher education and advanced research in all subjects and fields. Such support would provide for faculty salaries at a level competitive with government and industry, realistic support of advanced Ph.D. candidates, adequate support of research on a rational basis, and the proper amount of sub-professional and middle-professional backup staff for professors.

Some may dismiss this concept as Utopian, but I would call it just good business sense applied to the task of education.

The Pros and Cons

Why do universities still resist direct Federal support of higher education? I have heard the arguments that Federal money brings Federal control, a Federally supported school would have to open its doors to all and lower its academic standards, internal politicking would become more important than scholarship. I concede there are dangers.

The issue, however, is not whether universities are willing to accept a measure of interference in order to obtain Federal support. We already suffer that interference. The proposition is to get the needed support from a Federal agency that is responsive to the purposes of higher education, instead of from a military agency to which education is a sideline. Then the interference, if any, is likely to be of a more constructive sort. In my brief observations of nationally supported European universities, in reading scientific papers from such universities over the years, and in my contacts with European professors at such universities, I have found nothing to persuade me that Federal support of higher education is *inherently* dangerous.

On the other hand, citizens outside the sphere of education and many government leaders are beginning to move toward the principle of Federal support of higher education, despite the break with tradition that this represents. Here is a sampling of such views:

On Nov. 27, 1959, Arthur S. Flemming, Secretary of Health, Education and Welfare, told the Annual Convention of the Middle States Assn. of Colleges and Secondary Schools in Atlantic City: "I am convinced that the Federal Government must and will play an increasingly important role in the field of higher education. I am also convinced that higher education must play an increasingly important role in influencing the Federal Government's course of action if the Federal Government is to discharge its re-

sponsibilities in such a manner as to strengthen rather than to weaken our colleges and universities."

On May 7, 1960, at the 17th American Assembly held at Arden House, Harriman, N.Y., Sen. Joseph S. Clark (D. Pa.) warned against "an anti-government fixation on the part of universities that threatened to lead to a new anarchy." He said that some of the opposition to government aid created the impression "that to turn to Washington in time of need would be more like surrendering to a foreign power than utilizing one's own resources." He declared that the only real alternative to Federal funds would be "a second class educational system."

The Assembly admitted at the outset that the Federal Government is deeply involved already in higher education. The trouble is that it has been up to now an illicit relationship. The study set out to define ways of making the relationship legal, respectable, and permanent.

Although the final report of the Assembly, titled "The Federal Government and Higher Education," and published by Prentice-Hall, did not adopt Sen. Clark's views in their entirety, it contained this significant paragraph:

"The best available projections of total need leave serious doubt whether the required financial resources can be obtained from state and local governments, from tuition fees, and from private sources, including corporations. We urge that funds from these sources be expanded to the maximum, and repeat that no Federal action should operate to discourage them. Nevertheless, the need must be met."

At this point I should remark that Federal support will never erase the need for funds from private sources, particularly the philanthropic foundations and benevolent corporations. Because of its freedom of action, a foundation can step in and grant financial support to a new field or a new department, in a sense it can gamble, and thus boldly start something that might never get started under "regular" financing. In our own field of astronautics and aeronautics, the Guggenheim Foundations will always be remembered for the impetus they gave to these infant sciences by setting up Laboratories and Centers at Cal Tech, Stanford, Princeton, Columbia, and other institutions at the right times. Foundation money, wisely applied, will be an important supplement to any Federal support program that may be developed.

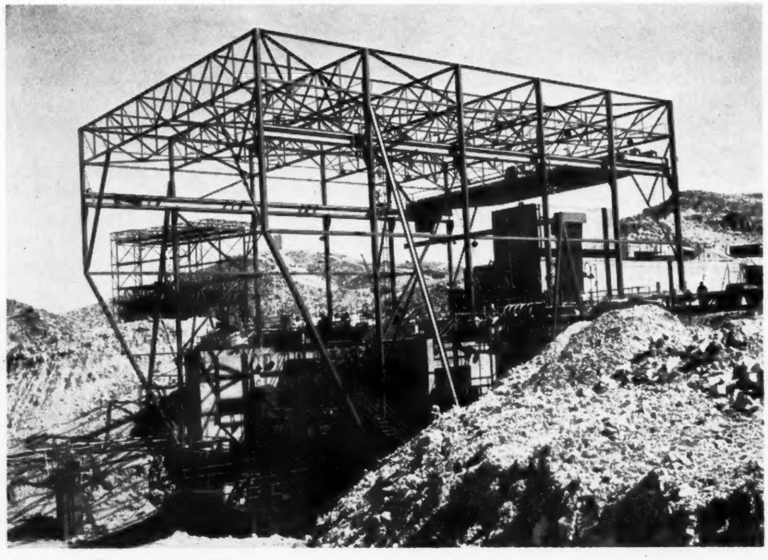
In its report on the annual meeting in Chicago of the American Council on Education, the *New York Times* wrote on Oct. 9, 1960, that "the conference theme was integrity of educational purpose, but the refrain was money, partly because poverty finds it hard to safeguard integrity." Throughout the meetings, the ghost of Federal aid appeared like an uninvited, not quite welcome, but very prominent guest. Although no direct endorsement was made of the principle of Federal aid, the general opinion emerged, as expressed by Dr. Everett N. Case, President of Colgate University, that "so far as higher education is concerned, Federal aid is a fact."

The most recent important expression of opinion was that of the President's Science Advisory Committee in its November report on "Scientific Progress, the Universities, and the Federal Government." The Committee recommended that the Federal Government assume an expanding role in supporting and improving scientific research and education in the universities, and deplored the growing undue emphasis being placed on research projects as a result of government contracts.

In commenting on the Committees report in its editorial columns on November 22, the *N.Y. Times* indorsed it in principle, and then went on to ask, "Have other fields of knowledge, such as the social sciences and humanities, no claim to similar assistance? There are many pressing national problems—the future of the dollar, the need for personnel competent to deal with the peoples of the underdeveloped nations and the like—for whose solution excellence in training and research is needed in economics, sociology, anthropology, philology and similar areas outside the physical sciences."

The time is rapidly approaching when some form of Federal support of higher education, direct and not by sponsored research, will have to be set up. The big questions will be: What will be its form? How will the funds be distributed? How much will be needed? What controls will the colleges and universities have to accept? What will be the rights of the Federal Government in determining how these funds will be administered within the universities? And there will be many other questions.

The ARS is a large and respected Society, and it has a proper concern with the problems and practices of higher education, particularly as they affect our special field of astronautics. I recommend that the Society, through its Education Committee, embark on a study of the problems of our universities in the areas I have suggested, and that it bring its considered opinion to the attention of the American public at a future date. ♦♦



Part of an F-1 Test

Thrust chambers for the $1^1/_2$-million-lb-thrust F-1 engine that Rocketdyne is developing for NASA under the Nova concept will be tested on this stand at Edwards AFB. Two other stands under construction will test the complete engine.

In Print

(CONTINUED FROM PAGE 21)

of that commodity available to help pressurize balloonets of such a craft.

The author also states emphatically that an unmanned Venus probe, as an example, would be "impractical," and suggests instead that a manned vehicle carrying 24 men should be sent to Venus at once, without preliminary work. (He chooses 24 as some ideal number for exploration and mutual support.) This idealistic statement indicates quite clearly that the author will be painfully surprised when he enters the missile business, something I hope he will not do, since this idealism would then evaporate in quick order. Actually, unmanned probes *can* be designed to supply data that will make the journeys of future astronauts easier, although I would agree that the ultimate machine for exploring Venus and Mars should be manned, provided that we can insure the astronaut's survival in the not exactly ideal space environment.

Like so many others, the author could not resist commenting on propellants, specific impulse, etc., which adds little to the book and merely rehashes existing material. He recognizes the importance of nuclear propulsion but mistakenly states that the I_{sp} of a heat-transfer nuclear rocket "does not exceed that of chemical rockets sufficiently to compensate for radioactivity difficulties and fuel handling problems." While those of us keeping an eye on the Rover program cannot make an accurate prediction as to the ultimate outcome, we can surely see enough potential to justify a statement that at least *twice* the I_{sp} of the best existing propellants can be obtained, and that shielding and logistics problems can be licked.

Again, in his exuberance, the author spends several pages on solar radiation pressure propulsors and plasma engines. Luckily, he does not seem to have worried about the fantastic structural problems involved in building solar sails, not to mention such questions as maneuvering in space. He even discusses some interesting methods of assembling and loading nuclear rockets and for "shooting interplanetary plasma jet fuel" from lunar electromagnetic accelerators to a rendezvous point over earth. Presumably, the earth-departing plasma rockets would capture this "fuel." The author rather expertly describes some of the phenomena of the planets beyond Mars and sanguinely states that "frozen gas deposits" on Pluto will help the astronaut refuel his rocket for the return voyage.

Godwin concludes not uncharacter-

istically with a chapter on interstellar travel, dismissing departure from the solar system as "not difficult." He mentions the photon "drive," calling it the ultimate means of travel. He does correctly note that the relativistic time-dilation effect will help (relatively, that is) whittle down the weary years it will take for an astronaut to reach the nearest stars.

So, in this well-planned, well-illustrated book, we have a young man's ideas about manned space exploration. Among his many optimistic statements are scattered suggestions of real technical, as well as philosophical, merit. The book points up the fact that many of our hoary Space-Age institutions need young idealists like this to dream of the impossible and needle the old-timers still working in this space business.

I hope many young people, and old hands as well, will read this book and so lose themselves in it as to forget for a few hours the grubby, every-day problems of money and leaky valves.

—Kurt R. Stehling
NASA

BOOK NOTES

In October 1959, the Rand Corp. held a two-day conference on **"International Political Implications of Space Flight."** Rand recently issued a full transcript of the conference, along with four papers especially prepared for presentation at the meeting, as Rand Report R-362-RC. The conference, sponsored by Rand with the assistance of the Rockefeller Foundation, brought together a number of Rand scientists, international lawyers, and foreign affairs specialists to discuss several major issues, including the development or banning of orbiting missile-carrying satellites; the impact of the space race on public opinion around the world; the legal status of overflying satellites; and the role of astronautics in stabilizing or upsetting the balance of military power. The 209-page report makes good reading.

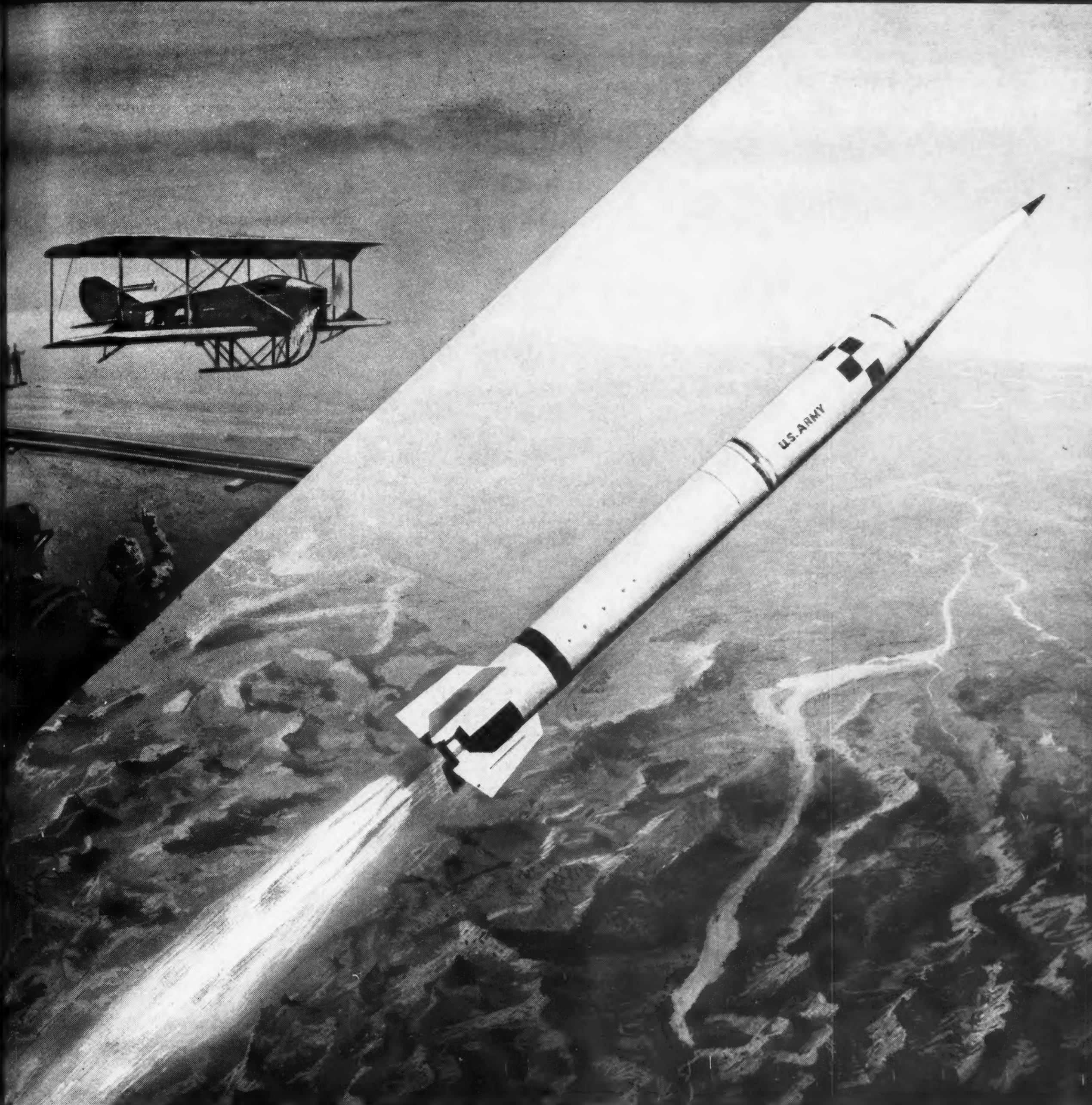
RECEIVED

Low-Temperature Techniques by F. Din and A. H. Cockett (Interscience Publishers, New York, N.Y., 216 pp., $6.50).

Selective Bibliography, The Photochemistry of Dyes, May 1959, compiled by Kenneth D. Carroll (Lockheed Technical Information Center, Missiles & Space Div., Sunnyvale, Calif., 52 pp.).

Tables of Osculatory Integration Coefficients by Herbert E. Salzer, Dexter C. Shoultz, and Elizabeth P. Thompson (Convair Astronautics Div. of General Dynamics Corp., San Diego, Calif., 43 pp.).

Second Colloquium on the Law of Outer Space, London 1959, Proceedings, edited by Andrew G. Haley and Welf Heinrich (Springer-Verlag, Vienna, 176 pp.). ◆◆


U.S. ARMY

People in the news

APPOINTMENTS

Brig. Gen. Austin W. Betts, formerly ARPA director, has been named director of AEC's Division of Military Application.

Col. John G. Zierdt, ARGMA commander, has been promoted to Brigadier General. **Col. Robert W. Van Wert** has been appointed director of field service operations of the agency.

Friedrich O. Ringleb, staff physicist at the Naval Air Engineering Facility (Ship Installations), Naval Air Material Center, has been appointed research physicist.

Ali Bulent Cambel, professor and head of the Dept. of Engineering, Northwestern University and an ARS director, has been named a national lecturer of Sigma Xi.

Gorge Rathjens has been upped from the Pentagon's Weapon System Evaluation Group to ARPA chief scientist.

Brig. Gen. Theodore Bedwell (USAF-MC), formerly SAC surgeon general, has been promoted to commander of the AF Aero-Medical Space Center, Brooks AFB, Tex., succeeding Maj. Gen. August W. Benson Jr. who has retired.

Robert E. Roberson, formerly vice-president, Systems Corp. of America, is now a consultant in astronautical guidance and control, operating out of 1100 N. Cerritos Dr., Fullerton, Calif.

Carl R. Culveehouse Jr. has been named manager, propellant loading operations, Grand Central Rocket.

Joseph B. Philipson, AEC director of operations for the National Reactor Testing Station, Idaho Falls, Idaho, has joined Aerojet-General's Solid Rocket Plant where he will perform scientific and technical assignments on development programs and advise on management matters.

John Huson has been appointed staff member for advanced weapons system simulator and training equipment requirements in the Washington office of Reflectone Electronics, Inc.

Charles E. Kaempen has organized a space technology consultant service called Astra Co. (Amerian Space Transport Co., Inc.), Seal Beach, Calif.

George A. Hoffman, Rand Corp. engineer, has been elected to the Board of Directors of Consumers Union, publishers of Consumer Report.

Edward H. Seymour has been elevated from director of research, Thiokol's Reaction Motors Div., to general manager of the division, succeeding **Raymond W. Young** who becomes director of Advance Planning.

A. Stuart Denholm will head the new Power Conversion Dept. recently formed at Goodrich-High Voltage Astronautics, Inc. **Sam V. Nablo** will direct the new Electrostatic Propulsion Dept., including an active colloid propulsion group. **Jason Weisman** has been named manager of operations for GHVA.

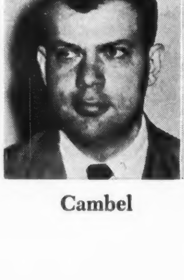
Louis F. Heilig has been appointed manager of engineering, Shillelagh program, Aeronutronic Div. of Ford Motor Co. Reporting to Heilig will be **Calhoun W. Sumrall,** appointed manager of vehicle engineering. In addition, **Victor D. Iglesias** has been named manager of the new Reliability and Quality Control organization; **Louis H. Brennwald,** acting manager, Prototype Manufacturing Activity; and **Nicholas Mastrocola,** manager, Programming and Controls.

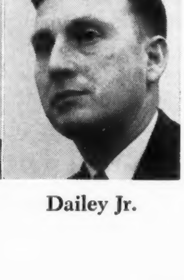
Niels C. Beck has been appointed assistant director at Armour Research Foundation, and **Italo Filosofo,** senior physicist.

Willis M. Hawkins has been made a vice-president of Lockheed Aircraft. **Lt. Col. William M. Prull** (AF-Ret.) has joined the Advanced Systems Research Dept., Military Systems Div., Lockheed Electronics Co.

Lt. Col. John A. Hancock (AF-Ret.) has been named manager, field offices, CBS Labs.

Edwin H. Spuhler has been appointed development manager, aerospace and military equipment in Alcoa's development division. **Lawrence W. Mayer,** succeeds Spuhler as manager, aero-space section, and **Edsel W. Johnson** becomes manager, military equipment section.





Cambel Dailey Jr.

Eugene L. Woodcock, formerly chief, development section, has been named to the senior technical staff, Perkin-Elmer's Electro-Optical Div.

Donald E. Garr has been named director of engineering at Raytheon.

D. L. Nettleton has been appointed chief engineer, RCA Electronic Data Processing Div.

The Operations Evaluation Group, sponsored by MIT, has appointed **Joseph V. Yance** to the research staff of the group's Applied Science Div. at Cambridge, Mass.

David D. Terwilliger has been appointed chief engineer of systems at the Precision Products Dept. of Nortronics, and **David W. Pertschuk** has been named director of reliability and quality control of the department.

Glenn A. Wilson has been appointed vice-president, purchases and special projects, Firth Sterling Inc.

Franklyn E. Dailey Jr. has been appointed manager, engineering and research, Ryan Transdata, Inc., and **Gordon L. Johnson** becomes manager of planning.

J. Trevor Law has been named senior engineer, Materials Dept., Motorola Semiconductor Products Div.

Clifford F. Abt has been promoted to manager, Research Dept., Arma Div., American Bosch Arma Corp., succeeding Bernard Litman who has been appointed to the division's newly created scientific staff.

J. H. Berryman has been named manager, Air Reduction Sales Co.'s Special Products Dept.

R. C. Vickery and **H. M. Muir,** co-discoverers of the recently announced thermoelectric "breakthrough" material, gadolinium selenide, have formed Electronic Materials Corp., Santa Monica, Calif.

Weldon R. Orme has been named manager, Flight Test Operation, GE's Defense Systems Dept., and **James Bush,** an oceanographer, has joined the department's Advanced Sea Warfare Systems group. **Robert L. Wooley** becomes manager, engineering operation, Light Military Electronics Dept.'s Armament Control Section; and **John A. Keyes** has been

named manager, communications satellite sales, GE's MSVD, replacing **A. T. Christensen** who is now manager, sales and contract administration.

Jack Durst has been named associate technical director, Pomona Div. of Marquardt Corp.

William E. Perkins has been promoted to associate technical director, Atomics International, a division of North American Aviation.

James B. Constable is manager of the new Lockheed Georgia Div. aerospace office, Sunnyvale, Calif.

Pierre A. Portmann has been promoted to assistant director in the R&D Directcrate of Page Communications Engineers.

Richard B. Uhle has been appointed assistant general manager, Avco's Electronics and Ordnance Div., and **Wayne D. Hudson,** assistant general manager, Nashville Div.

George J. Dickey has been named vice-president and assistant general manager, Stromberg-Carlson Div., General Dynamics.

Robert C. Dunlap Jr. has been elected vice-president of Texas Instruments, and will continue as president, Geophysical Service, Inc., a TI subsidiary.

Albert J. Morris has been appointed president of Radiation Inc.'s newly formed subsidiary, Radiation, Stanford, Calif.

Stuart L. Bailey has been elected a vice-president of Atlantic Research.

HONORS

Laurel van der Wal, head of the bioastronautics group at Space Technology Laboratories, has been named the outstanding woman scientist and

one of the 10 Women of the Year for 1960 in the annual *Los Angeles Times* "Women of the Year" awards. She was cited for having conceived and planned the first Thor-Able rocket flight carrying a mouse in its nose cone. ♦♦

NEW PRODUCTS CATALOGUE

EQUIPMENT . . . PROCESSES . . . MATERIALS . . . LITERATURE

Gyros

Floated Rate-Integrating. For missiles; group of miniature, lightweight gyros; operating life, 1000 hr; weights from 0.7 to 0.9 lb; max altitude unlimited. **General Precision, Inc.,** Kearfott Div., Little Falls, N.J.

Fluid-Filled Rate. For application in autopilots, telemetering instruments, radar antenna stabilization, fire-control systems and solid-propellant missiles; most parts interchangeable; diam, 1 in; length, 2.45 in. **General Precision, Inc.,** Kearfott Div., Little Falls, N.J.

Pyrogyro. In the Giannini "Pyrogyro" a 3-gram charge inside the rotor is ignited electrically; gases provide a jet-like impulse that brings the rotor to 36,000 rpm within 0.1 sec, runs 4 min. (Illustrated.) **Hercules Powder Co., Inc.,** Wilmington, Del., produces special charges.

Gas Driven. Displacement gyro with four moving parts, used for short-range missiles, drones and target vehicles; when firing button is pressed, a solid or liquid propellant accelerates the gyro to high speeds; drift rate, 2 to 4 deg per min. **Lear, Inc.,** Grand Rapids, Mich.

Instruments

Batch Sampler. Prepares for analysis any low-boiling-point liquid; designed for lox quality control; captures a measured all-liquid sample and converts it to a gas in the closed system. **Air Products, Inc.,** Allentown, Pa.

Spectrophosphorimeter. Permits excitation of compounds and measurement of resulting phosphorescence throughout the ultraviolet and visible regions. **American Instrument Co., Inc.,** Silver Spring, Md.

Mercury-Vapor Meters. Provide instantaneous, direct readings of toxicity levels of mercury vapor in enclosed areas; three models; 115-v AC, 50/60 cycle; power, 15 w. **Beckman Scientific and Process Instruments Div.,** Fullerton, Calif.

Electrolytic Hygrometer. Measures moisture content in hydrogen-gas streams; cell is capable of removing and electrolyzing most water from hydrogen, with little recombination. **Beckman Scientific and Process Instruments Div.,** Fullerton, Calif.

Bidirectional Windvane. Fast-response, low-inertia instrument records vertical and horizontal wind directions; for detailed studies in azimuth and elevation angles simultaneously. **Gelman Instrument Co.,** Chelsea, Mich.

Air Sampler. Collects dust samples on a paper tube; periodic advancement of tape provides record of air-pollution toxic gases detected by using special sensitized tapes; wt, 20 lb. **Gelman Instrument Co.,** Chelsea, Mich.

Ozone Recorder. Concentrations measured and recorded on 6-in. strip chart; weatherproof case enables stationing meter at remote outdoor locations. **Mast Development Co., Inc.,** Davenport, Iowa.

Flow Calibrator. Handles JP-4, JP-5, gasoline, kerosene, water, and hydraulic oils; accuracy 0.25 per cent of reading for fuel flow from 100 to 100,000 lb/hr. **Potter Aeronautical Corp.,** Union, N.J.

Additional information about any of the products, equipment, processes, materials and literature listed on these pages may be obtained by writing to the New Products Department, ASTRONAUTICS, 500 Fifth Avenue, New York 36, N. Y.

Spectrum Analyzer. Three models, each with 100 filters to analyze signals; operate in several bands within 50-cps to 100-kc spectrum; applications include shock and vibration studies. (Illustrated.) **Raytheon Co.,** Commercial Apparatus and Systems Div, Norwood, Mass.

Materials

Oil Additive. Nadone cyclochexanone, a lubricating-oil detergent additive increases normal life of aircraft engines by preventing hard carbon and sludge. **Allied Chemical Corp.,** National Aniline Div., New York, N.Y.

Urethanes. Solid urethanes can be compounded in roll, sheet, tube, rod, and cast parts; high tensile strength combined with elasticity and resilience in varying degrees. **Armstrong Cork Co.,** Industrial Div., Lancaster, Pa.

Silicone Elastomer. Silastic Type K interlayer supplied in sheets for laminating between glass and clear plastics; tensile strength, 1000 psi. **Dow Corning Corp.,** Midland, Mich.

Porous Metal. Refined process to obtain controlled porosity in stainless steel, iron-nickel alloys, and other high-temperature metals; complex shapes as well as flat stock. Stainless-steel hemisphere. (Illustrated.) **Mott Metallurgical Corp.,** Hartford, Conn.

Ceramic Coatings. Flame-spray system for applying pure oxide refractory coatings to metals; alumina and zirconia are efficiently deposited. **Norton Co.,** Refractories Div., Worcester, Mass.

Boron Hydrides. Laboratory quantities of decaborane and pentaborane now available for experimental uses. **Olin Mathieson Chemical Corp.,** New York, N.Y.

Elastomeric Compound. For use with nitrogen tetroxide (N_2O_4); compound B496-7 especially developed as a sealant for this propellant. **Parker Hannifin Corp.,** Parker Seal Co. Div., Culver City, Calif.

Motors

Axial Blower. C-20-37 induction motor features low noise and high efficiency; open ventilated; speed, 22,300 rpm; hp, $^3/_4$; torque (full load), 2.83 oz-ft; wt, 3 lb 10 oz. **General Precision, Inc.,** Kearfott Div., Little Falls, N.J.

Fan-Cooled. BF-15-14 induction motor designed as driving unit for diverse fuel, air and hydraulic pumps; continuous duty; hp, 0.03; torque (full load) 3 oz-in.; wt, 1 lb 9.75 oz. **General Precision, Inc.,** Kearfott Div., Little Falls, N.J.

DC Milliwatt. Miniature motor operates on DC in a vacuum over wide ambient temp range; voltage, 6-v DC; running current (no load), 3 ma; power, 18 mw; wt, 55 gm. **Giannini Controls Corp.,** Duarte, Calif.

Variable-Speed Drive. Available with right-angle and helical gears; speed ranges from 4660 to 1.2 rpm with up to 10 variations; hp ratings, $^1/_4$, $^1/_2$, and $^3/_4$ hp. **Sterling Electric Motors,** Los Angeles, Calif.

Bearing. For radial loads of 25 to 30 lb at speeds of 500 to 4000 rpm with moderate thrust loads; OD, 1.181 in.; shaft diam, 0.4995 in.; lengths up to 6 in. **Tann Corp.,** Tan Bearing Co. Div., Detroit, Mich.

Optical Equipment

Azimuth-Error Indicator. Permits azimuth mechanism in a missile's inertia-guidance system to receive constant precise settings from the fire-control system prior to launching; used in launching Polaris missiles from submerged submarine. (Illustrated.) **Bausch & Lomb Optical Co.,** Rochester, N.Y.

Super Baltar Lenses. New series includes eight lenses with focal lengths from 20 mm to 9 in. (speed of f/2); all focal lengths cover 35-mm motion picture frame, and lengths from 3 to 9 in. cover 70-mm frames. **Bausch & Lomb Optical Co.,** Rochester, N.Y.

Flash Illuminator. For close-ups and microscopic subjects in color or black and white; input to lamp, 100 watt-sec; flash duration 150 microsec; source size, 4 mm by 1.5 in. **Edgerton, Germeshausen & Grier, Inc.,** Boston, Mass.

Electro-Optical Shutters. Operates in nanosecond (10^{-9}) time domain; hermetically sealed Kerr cell composed of 2 flat plates immersed in a fluid which becomes birefringent upon application of an electric field. **Electro-Optical Instruments,** Pasadena, Calif.

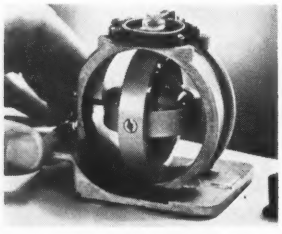
Plastic Lenses. Low-cost optically ground and polished lenses in wide variety of sizes, shapes, and types; transmit 7 per cent more light than glass lenses. **Fostoria Corp.,** Huntingdon Valley, Pa.

Light Source. Electroluminescent; can be adjusted flat against wall or at any angle up to 90 deg; has three outlets into which other electrical equipment may be plugged. **General Electric Research Lab,** Schenectady, N.Y.

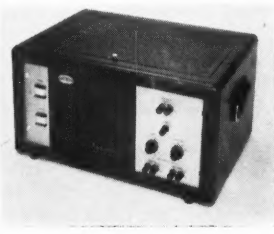
TV Camera. Closed-circuit for monitoring rocket launchings; transistorized; enclosed in housing of spun aluminum; 650-line horizontal resolution; uses 16-mm lens. **GE Communication Products Dept.,** Lynchburg, Va.

Infrared Viewer. Portable unit weighs 2.5 lb with batteries; pistol-grip handle with on-off trigger; packaged in leather case. **ITT Industrial Products Div.,** San Fernando, Calif.

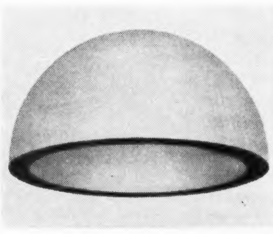
Portable TV Camera. Model 81, small lightweight camera for industrial use; transistorized circuits; will operate remotely; resolution 800 lines horiz; size, 5 x 5 x 20 in.; wt, 15 lb.



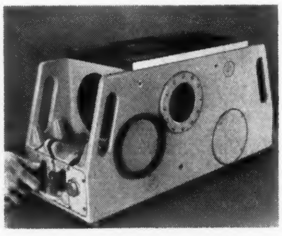
Pyrogyro



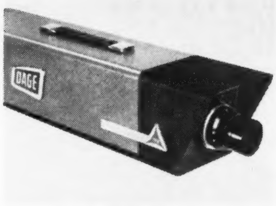
Spectrum Analyzer



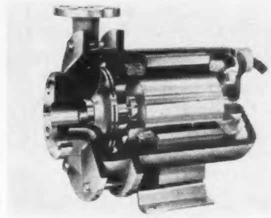
Porous Metal



Azimuth-Error Indicator



Portable TV Camera



Leak-Proof Motor-Pump

(Illustrated.) **TRW Dage Television Div.**, Michigan City, Ind.

Pumps

Pulsation Eliminator. High-pressure ripple filter reduces to 1 per cent or less of system pressure; has no moving parts; compatible with all liquids; working pressures to 25,000 psi, and temp from –450 to 1000 F. **Auto Control Laboratories,** Inglewood, Calif.

Water Circulator. Motor and pump combined in single leakproof unit; Model 400A handles up to 90,000 Btu/hr in systems or zones with 20-F temp drop; wt, 11 lb. **Fostoria Corp.,** Dynapump Div., Fostoria, Ohio.

Vacuum Ion-Pumps. Contain no moving parts, refrigerants, traps, oils nor heating elements; lightweight 6-liter model pumps at rate of 6 liters/sec; can be used as vacuum gauge. **Hughes Aircraft Co.,** Culver City, Calif.

Leak-Proof Motor-Pump. For dangerous and expensive fluids; self-contained unit, material being handled circulating within motor; impeller connects directly to motor shaft; 1/2, 3/4, and 1-hp ratings; capacities to 63 gpm. (Illustrated.) **Robbins & Myers, Inc.,** Springfield, Ohio.

Cooling Package. Vane pump with integral relief valve and electric motor for aircraft and space vehicles; pump delivers 1.05 gpm at 90 psig; 1000 hr continuous duty. **Sperry Rand Corp.,** Vickers Inc. Div., Detroit, Mich.

Vane Motorpump. Circulates coolant (ethylene glycol and water) through magnetron tube of a ground-radar high-power illuminator antenna for guidance system of missiles; pressure 300 psi; 3-phase, 400 cps motor. **Sperry Rand Corp.,** Vickers Inc. Div., Detroit, Mich.

Vacuum Roughing. Sorption pump designed to evacuate systems, especially ion-pumped systems; liquid nitrogen used as chilling agent during pumpdown cycle. **Ultek Corp.,** Palo Alto, Calif.

Structures

Variable-Incidence Fins. Replacements for those on Nike Ajax booster; successfully tested in Cree program; available in a number of configurations for use on first-, second-, or third-stage motors. (Illustrated.) **Atlantic Research Corp.,** Alexandria, Va.

Plasmionic Deposition. High-vacuum process for depositing numerous alloys and other materials onto substrate materials including ceramic, glass, bakelite, Teflon, mylar, fiber glass, quartz, and mica. **Atohm Electronics,** Sun Valley, Calif.

Ball Bearing. BarTemp for synchros, motor, blowers, and fans operating at high temperatures; stainless-steel bearing rings; ball retainer of Teflon compounded with solid lubricant; 0.3125 to 0.7480-in. OD. **The Barden Corp.,** Danbury, Conn

Fused-Silica Casts. For brazing complex contoured stainless-steel honeycomb panels; no measurable shrinkage from drying or firing, so tolerances of the plaster mold are retained in the silica cast. (Illustrated.) **Boeing Airplane Co.,** Wichita, Kan.

Permanent Plastic Magnet. Hair and foam microwave absorbers backed with flexible magnetic strips; simplifies installation in shielded anechoic test chambers having ferrous metal walls. **B. F. Goodrich,** Sponge Products Div., Shelton, Conn.

Static Metal Seal. Machined from high-temperature steel to produce a gas-tight connection at 700 F and 2000 psi; a 35-in. seal is used in an experimental atomic reactor. **Harrison Mfg. Co.,** Burbank, Calif.

Mounting Systems. Elastomeric structures custom-designed to consolidate such systems as communications, navigation, flight control, countermeasures, and fire control on one base; provide shock and vibration protection over –65 to 300 F range. **Lord Manufacturing Co.,** Erie, Pa.

Printed Circuits. Direct-printed on ceramics or glass; applied on flats, tubes, rods, cones, and other geometric shapes; silver inks assure high bond-strength. **Frank Motson Co.,** Flourtown, Pa.

Window Seal. For sealing germanium windows to infrared detectors; glass frit mixed with amyl acetate painted on sealing surface of a germanium disc and then fused to another glass having comparable thermal-expansion coefficient. **Philco Corp., Landsdale Div.,** Lansdale, Pa.

Plasma-Jet Spray. Hand-held Plasmatron gun sprays epoxy resins onto any surface for coatings of any desired thickness. **Plasmadyne Corp.,** Santa Ana, Calif.

Sapphire Window. A 12-in.-diam window, assembled by bonding 26 square synthetic-sapphire prisms, is used in an airborne infrared-testing laboratory; withstands pressure of 28 psi; bond strength in shear, 4000 psi. (Illustrated.) **Precision Lapping Co., Inc.,** Valley Stream, N.Y.

Fiber-Glass Laminates. Epoxy-impregnated material for light and tough high-pressure cylindrical or spherical shapes; does not shatter under high impact, and resists attack by many chemicals. **Smooth-On Mfg. Co.,** Jersey City, N.J.

Closed-Die Forging. An 8-in. rocket-nozzle entrance has been forged from a 3.5-in.-diam ingot of electron-beam processed grain-refined tungsten; processed by technique which refines grain size of refractory metals. **Stauffer Chemical Co.,** Ladish Pacific Div., Los Angeles, Calif.

Filament-Wound Bottles. Filament-wound reinforced structures for the aerospace industry; pressure vessels have strength-density in excess of 3 million in-lb per lb, with integrally-wound end closures. (Illustrated.) **Thompson Ramo Wooldridge Inc.,** Cleveland, Ohio.

Corrugated Metal. Machine forms aluminum, brass, copper, stainless and regular steel, as well as plastic; patterns can be bent, sheared, embossed, or stretched. **Twin Coach Co.,** Buffalo, N.Y.

Switches

Pressure. May be pre-set to actuate in 5- to 100-psig range with tolerance of ± 1 psig; switch isolated from pressure media, current rating, 2 amp resistive at 28-v DC or 110-v DC; wt, 2 oz. **Aero Mechanism, Inc.,** Van Nuys, Calif.

Rotary. Blue Line switches built around a stage containing four isolated double-break silver-alloy contacts; up to 12 stages in a column; up to three columns in an assembly. **American Solenoid Co., Inc.,** Union, N.J.

Digiswitch. Series 7300 is a compact switching element for converting visual decimal settings to computer-cord outputs; lighting assembly operated at 1.5 v; operating life, 2500 hr. **The Digitran Co.,** Pasadena, Calif.

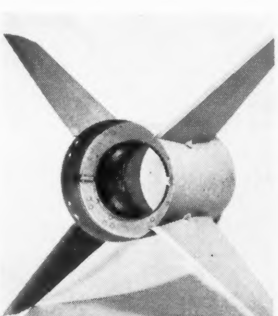
Solid-State. Switching device samples data from multiple sources on a time-sharing basis; standard scan rates of up to 25 kc; different models accommodate from 2 to 100 channels. **Electric Systems Development Corp.,** Ventura, Calif.

High-Speed Rotary. Size 8; power capacity, 10 to 12 v and 5 to 10 milliamp; torque, 0.05 in-oz (room temperature); max speed, 700 rpm; wt, 1 oz. **General Precision Inc.,** Kearfott Div., Little Falls, N.J.

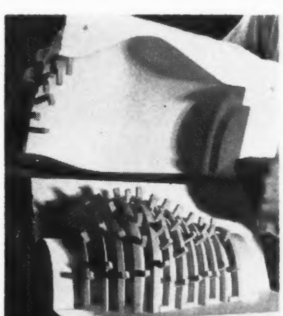
Flip-Flop. Device incorporates timing delay of from 2 to 300 sec; transistorized; operates off negative 20 v power input, two signal inputs (start and stop), and two outlets; retriggering time, 50 millisec. **Hydro-Aire Co.,** Burbank, Calif.

Explosive. Miniature switch has no moving parts; explosive action establishes large-area permanent contact; capacity, 20 amp; temp range, –100 to 400 F. **Mimx Corp.,** Glendale, Calif.

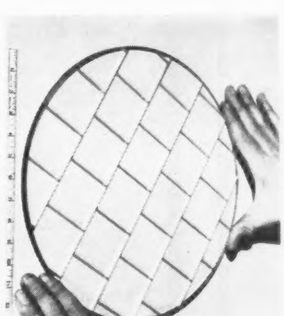
Micro-Energy. Switch operates 10-mc binary counter using 4 mw of power; for fast switching rates at low power levels in microminiature electronic equipment. **Philco Corp.,** Lansdale Div., Lansdale, Pa.



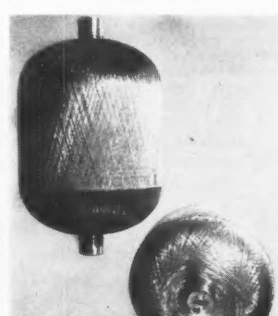
Variable-Incidence Fins



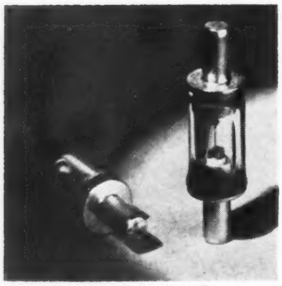
Fused-Silica Cast



Sapphire Window



Filament-Wound Bottles



Microwave Diode

Microwave Diode. X-band switch; insertion losses less than 2 db, and isolation values greater than 18 db at 9300 mc; mount has flanges for incorporation into waveguide systems. (Illustrated.) **Philco Corp.**, Lansdale Div., Lansdale, Pa.

Solid State. Model EA 154 for airborne and ground-control missile applications; input, 110-v AC, 400 cps; rating, 2 amp at 28-v DC; shock, 25 g for 10 millisec. **Norris-Thermador Corp.**, Thermador Div., Los Angeles, Calif.

Lighted Push Button. Model 801 for dry-circuit to 3-amp operation; single pole to 6 poles, double throw or single throw; easily installed; mount on 1-in. centers, horizontally or vertically. **The Sloan Co.**, Color-Lite Div., Sun Valley, Calif.

Push-Pull. Type G-16 Switch for radio and TV receivers, instruments and other electronic assemblies; furnished on many single- and dual-section variable resistors; shaft rotation controls variable resistance functions. **Stackpole Carbon Co.**, Electronics Components Div., St. Marys, Pa.

Binary-Encoding. Switch links pushbuttons mechanically to common contact array; contact rating 3 amp at 120-v AC, or 1 amp at 120-v DC; 10-button unit permits stacking up to 16 switches. **Telex, Inc.**, Special Products Div., St. Paul, Minn. ♦♦

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